McGraw-Hill Publishing Company, Inc.
James H. McGraw, *Chairman of the Board*
Malcolm Muir, *President*
H. C. Parmelee, *Editorial Director*

POWER

FRED R. LOW, *Editor*

Irving Fellner
Publishing Director

Volume 68 New York, December 25, 1928 *Number 26*

Merry Christmas

Spruce and holly and ground pine, little lights and scarlet berries, the mingled scent of the pine woods and spicy Christmas goodies; mysterious packages embodying so much of thoughtful effort on the part of their donnors to add to the pleasure of the day.

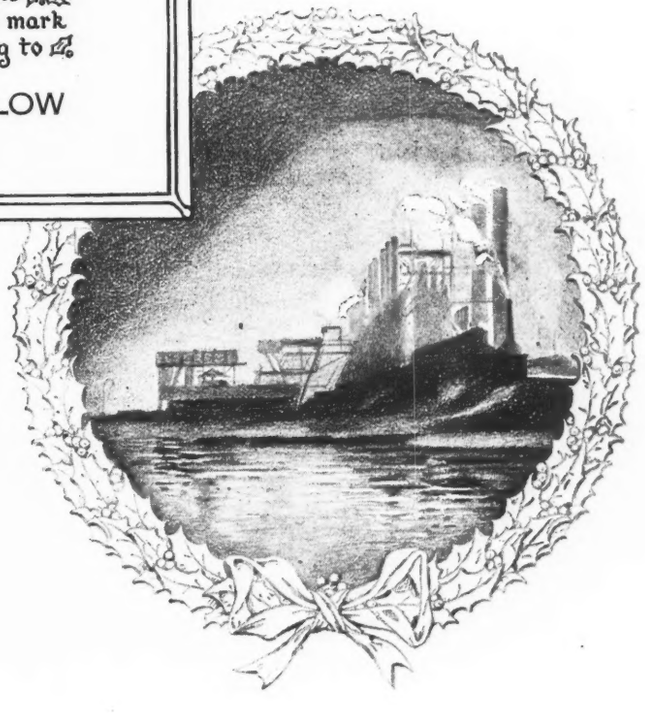
You have had part in greater things than these, but thoughts of them do not recur to make life pleasant one half so often as those of the sparkling happiness to which you have contributed on occasions such as this.

And a long and oft-recurring shadow may be cast across the years by recollection of a pain or disappointment caused by your neglect or lack of appreciation.

It is not its big event that makes up a life.

POWER wishes for one and all a full measure of good cheer and may the Christmas Spirit of universal goodwill mark this festival and continue increasingly to pervade the years.

F. R. LOW



POWER *Stands for . . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**

Operating Methods That Save

IN POWER-PLANT maintenance there is entirely too much of the old herb-woman attitude. Troubles appear, and instead of a complete diagnosing of the causes and the application of the proper corrective measures as revealed by the study, home-made remedies are seized upon, or the engineer blindly follows the advice of some other engineer equally unfamiliar with the true state of affairs.

Corrosion has been going on in the ice plant ever since Linde built his first machine. A thousand and one remedies have been advanced. Some of them occasionally do the trick when conditions are right and are then recommended unqualifiedly for all cases of corrosion.

It has been discovered that the concentration of hydrogen ions in a brine, or in any liquid, decides the corrosiveness of the liquid; if too small an amount is present the brine is acidulous, and if too much exists, the brine is alkaline. Instead of the home-made remedies so often employed, the engineer should obtain a simple hydrogen-ion testing set and find in what condition the brine is. With this knowledge available he is able to apply the proper corrective.

Engineers Are Not as Politicians Paint Them

POLITICIANS often cast doubts upon the human qualities of an individual in order to discredit him before election. In the heat of a campaign, such propaganda may be disregarded. But when it is continued after an election, with the apparent intention of discrediting the administration of the successful candidate, it is time for protest.

And it is doubly time for protest on the part of engineers, when the propaganda concerns Herbert Hoover and the engineering profession in general. An attempt is apparent in certain quarters to foster the opinion that engineers are, because of their profession, lacking in warmth of feeling and appreciation of human values. It is suggested that: "The engineer has to do, not what he would like, but what he must. He has to deal with his materials as he finds them. If they are highly refractory, they constitute only a new challenge to his ability to hew out a way around obstacles which he cannot surmount and to meet unexpected difficulties with clever devices."

There is just enough truth in such a statement to make it particularly dangerous. It is true that "he has to deal with his materials as he finds them." But these materials are, in the main, human beings. Even in this machine age, men are, and will remain, the most important factor in industry. No engineer can be successful—and President-elect Hoover is above all else a successful engineer—unless he understands men and treats them with justice and humanity. Detractors of the profession show only ignorance when they take any other stand, and the general public should give their misleading statements little attention and no belief.

Alloy Steels in the Power Plant

THE development of alloy steels for machine parts and for tools has advanced to a degree of perfection which makes their use almost a matter of course. This is due to superior strength or hardness, or the like, and has resulted in great advantages to the industry.

In a similar manner alloy steels mean much to the power plant. As is well known, simple carbon steel exhibits a rather sharp reduction in strength at temperatures much above 750 degrees Fahrenheit, is subject to corrosion and erosion and is not highly resistant to vibration and shock. Alloy steels, on the other hand, are available with the reverse of one or more of these properties in various combinations.

Chromium, it seems, makes a steel highly resistant to corrosion—"stainless" steels are virtually all high chromium alloys. This constituent also raises the strength of the metal, at the expense of ductility, it is true; but, what is more significant, it raises by one or two hundred degrees the temperature at which strength decreases sharply. Nickel develops steels of great strength at temperatures not too high. Molybdenum has much the same effect and, in addition, imparts a high resistance to vibration and shock. Tungsten steels retain a high degree of hardness even at red heat, and are used for high-speed steels and for the valves of internal-combustion engines. The catalog of possibilities is both extensive and highly varied. Almost any desired combination of properties can be produced.

The uses of such material in the power-plant field are many. One of their recent fields is in valves, fittings and bolts for high-pressure and high-temperature conditions. Alloy-steel bolts and studs have long been used with excellent results. Stainless steel has marked advantages for certain valve parts, such as spindles and disks. Nickel-steel castings for valve bodies and fittings make possible a considerable reduction in weight and size. With the increasing pressures now becoming general, this is of no small importance.

But a word of warning is necessary. Alloy steels must

be well made, and the work may safely be assigned to none but thoroughly trustworthy hands. Castings are usually especially difficult to produce with uniform reliability. And then the properties of such metals depend to a surprising extent upon the heat treatment to which they are subjected, and in some cases this is a process very difficult to control. Stainless steel, for example, is air hardening, and it is really not easy to anneal it. The heat generated in machining is sometimes sufficient to set up air hardening to a dangerous degree. In one case a valve spindle, newly machined and not subsequently annealed, rolled from a bench and broke on striking the floor. Air hardening had made it brittle. Alloy steels of all sorts require skillful handling under expert supervision through searching inspection and unremitting testing of the product. Only the most reliable firms may safely be trusted to produce dependable results.

This must not deter the engineer from an intelligent application of these valuable materials. Progress demands their increasing use. On the other hand, the time is not ripe for standardizing their use in general. Much is known, but much has yet to be learned. Manufacturers are conducting research and developing practice. Already the more successful of them are prepared to furnish dependable material. The future is full of hope.

Fact or Fancy?

DISCUSSION of R. V. Kleinschmidt's paper on "Balancing Heat and Power in Industrial Plants," at the recent annual meeting of the American Society of Mechanical Engineers brought out some extremely peculiar opinions. These were so far from correct that, lest mistaken ideas be implanted thereby, it is necessary to point out the fallacies.

The argument was advanced that it does not pay to modernize industrial power plants, but is better to make the best of existing boiler installations for heating and process steam, while all current should be purchased from public utilities. The reason given for this opinion was that industry cannot afford the capital expenditures necessary for power-plant modernization and that the utilities can always furnish electric power more cheaply than any other source.

Such generalizations are, of course, ridiculous. There are undoubtedly some cases in which an industrial plant with an appreciable steam consumption cannot make electric power at a cost lower than that for which it can be purchased, but they are few. In plants using no process steam and but a small amount of steam for heating, purchased current is often the most economical. But where the steam consumed for purposes other than generation is a fairly large part of the total steam made, it is almost invariably profitable to incur the expense of installing a modern, high-pressure boiler plant and modern generating equipment. Case after case, described at length in the columns of *Power* and other engineering journals, makes this certain.

For any industrial plant, whatever the relation of steam and electric consumption may be, a sound, impartial study of the problem of furnishing power should be made before any new equipment is installed or any other changes made. Purchased current is a source of saving in many plants, while generated current brings economy to numbers of others. Which is used should be determined upon an engineering basis, not on the strength of anyone's dogmatic generalization.

Yankee Ingenuity

A HUNDRED years ago "engineering" did not exist. One man's guess was almost as good as another's. Pure science was still groping in the shadows of astrology, and as for applied science, practically speaking, there was no such thing. If the farmer's wagon broke down, he fixed it himself; there were no service stations. Originality and the pioneering spirit led men to devise short cuts for laborious jobs, and inevitably engineering principles followed. And like many another fine motivating impulse, the cause was soon lost in the effect, so that today ingenuity is spoken of lightly, as of no importance. Can openers and perpetual-motion machines still result from it, but the lives of the public, in this tremendous age of machines, depend upon sound, fundamental knowledge.

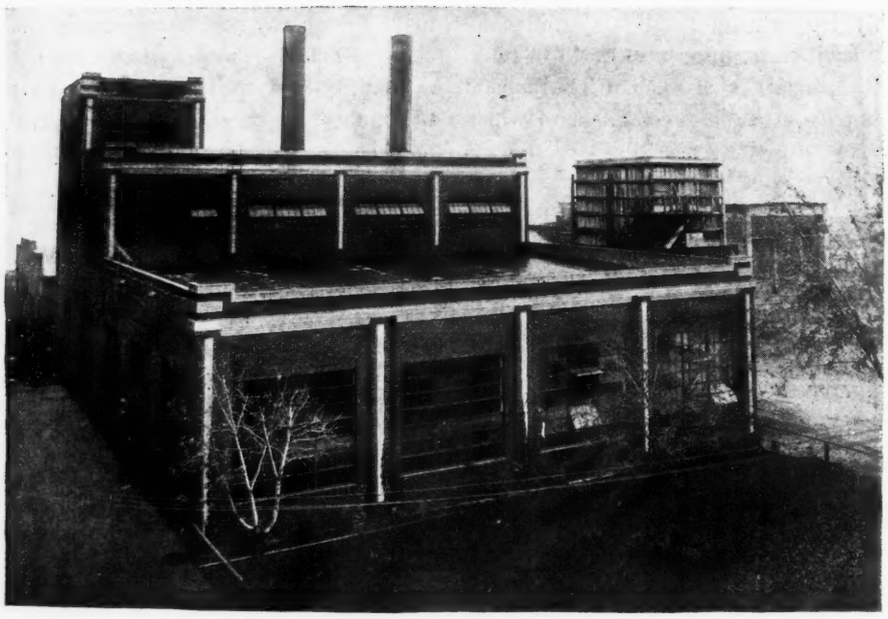
But is ingenuity really a joke? Hardly. It is simply submerged beneath a mountain of knowledge. The spirit of the pioneer is still there, as essential as ever. The man who is ingenious but untrained still has the opportunity to do great things, for the gift he has is far rarer than the possession of a college degree. Ingenuity is the life-giving principle; knowledge only the stock in trade. A man can get knowledge by sitting up nights and being wide awake in the daytime. But the ability to strike out into new channels, even to see that such exist, is not bought by midnight oil; it is a heritage to be jealously guarded.

Nomenclature Standardization

ONE of those annoying little things that makes the reading of engineering literature just a little harder is the great variety of symbols used to express the same quantity. Much has been done by the A.S.M.E. and the American Engineering Standards Committee to improve this condition by establishing standard definitions and symbols for various fields of engineering and scientific work, but the difficulties are not yet overcome.

The language in heat-transmission work has long been in a chaotic state. In fact, each worker has used whatever symbols occurred to him as convenient. Recently, however, a subcommittee of the National Research Council headed by Dr. E. F. Mueller, of the Bureau of Standards, submitted a report which suggested standard symbols and definitions for use in heat-transmission work.

Any work tending to standardize nomenclature is to be commended and will be welcomed by all who practice and study engineering. It is hoped when this report is finally published, that authors of papers and texts on this subject will consult it and follow it in their work.



Power house of the Gates Rubber Company, Denver, Colorado

Plant Built Out of Its Own Savings

Without Tying Up Manufacturing Capital

By C. R. Ahlquist
Chief Engineer, Gates Rubber Company

HOW the Gates Rubber Company, of Denver, Colorado, has solved an interesting power problem without cost to itself is worthy of study.

The Gates factory had a small one-man and one-boy beginning, but it has grown year by year until it now has a payroll of 1,200, and ships its products over all the world.

This company enjoys the distinction of being the largest manufacturer of fan belts in the world and makes over one hundred other products of rubber and fabric, principally for the automotive field, although it also serves railroads and other large industries. Tires, fan belts and hose, however, form the bulk of its output.

The company operates its own rubber reclaim plant, which produces the raw material of many mechanical rubber products; and another instance of its self-supporting policy is its machine shop, where it makes its own mold equipment, including tire molds.

These points are mentioned to show that this company had the essentially independent viewpoint which made a private power plant feasible. Another factor contributing to the success of the power plant is the fact that rubber manufacturing requires a large volume of steam for essential processes.

The demand for power used by the factory, until recently, has been met by the purchase of electric energy from the Public Service Company of Colorado. The company produced its own process steam.

The combination of these two requirements had long appeared desirable, but was brought to a head a year and a half ago, when the Public Service Company secured a new franchise in Denver and found that by reason of it they could increase rates.

Notification of increased rates started an investigation, the results of which indicated clearly that, because of the large amount of process steam used, a combination of power generation and steam utilization would be economically sound. Before this decision was reached every factor, favorable and unfavorable, was given consideration.

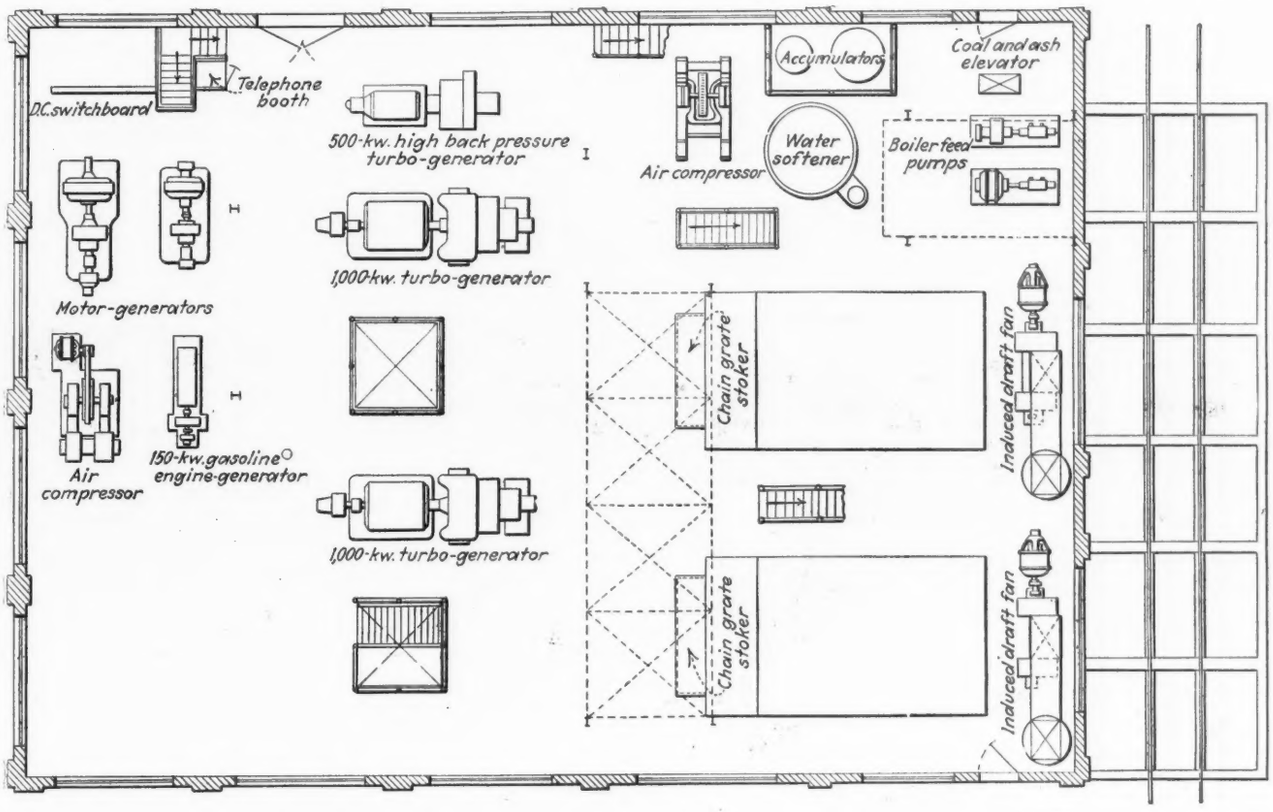
One condition particularly favorable was the water situation. A few years ago the Gates Rubber Company, finding its water requirements rapidly increasing and the cost of its purchase from the Municipal Water Department a growing burden, decided to prospect for a private supply.

A geological survey indicated an abundant supply close at hand and drilling operations proved successful, producing 1,000,000 gal. a day from a depth of 40 ft. Automatic motor-driven Layne-Bowler pumping equipment was installed, and this well has since produced continuously at 80 per cent capacity, providing 95 per cent of the factory's total requirements.

From the foregoing it will be seen that the problem of water had to be taken into consideration in designing the new power plant. The company's private supply was sufficient, provided it could be correctly treated for process requirements and for use in the boilers and adequately conserved for re-use.

The Neckar Water Softening System was adopted by the engineers and installed with a capacity of 26,000 lb. of makeup water treated and softened per hour

in addition to handling the entire boiler feed water. The system consists of one softening tank, one soda tank, one stabilizer and the necessary valves for controlling the continuous blowoff from the boiler to the from the low-pressure steam line through a temperature controller. Two water-tube boilers, each having 6,130 sq.ft. of heating surface, furnish steam at 400 lb. pressure and 250 deg. F. superheat. Before leaving the boiler



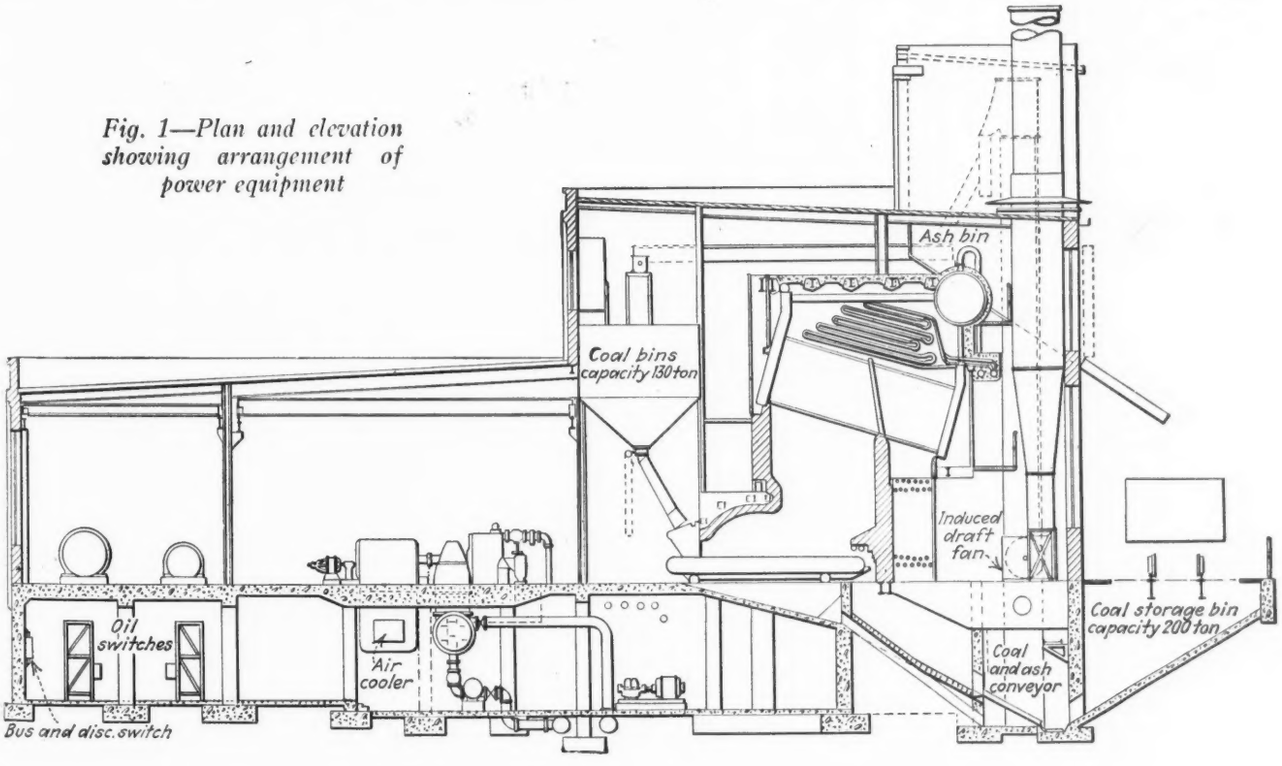


Fig. 1—Plan and elevation showing arrangement of power equipment

system. There is sufficient exhaust steam available from the factory to keep the feed water at a proper temperature for operation through a water heater of the open deaërating type, but provision is made for supplying steam drums the steam is cleaned by internal type purifiers. Feed water is heated in 2,376-sq.ft. steel-tube economizers located at the back of each boiler on the operating floor level. Flue gas from the boilers passes down over the

economizer tubes to induced-draft fans at the base of 5-ft. diameter, 60-ft. high steel stacks. Each boiler is served by a separate stack.

Coal is burned on chain-grate stokers, each having a projected area of 165 sq.ft. and equipped with water-cooled rear shafts. A concave-convex type front arch 11 ft. 4½ in. wide by 8 ft. 9 in. long insures proper ignition of the green coal.

Automatic combustion control of the step type regulates the stoker and induced-draft-fan motors to meet the steam demand.

The equipment for handling the coal has been designed to convey 35 tons an hour from a concrete track storage bin of 200 tons capacity to steel bunkers having an average capacity of 130 tons. The bucket elevator, which also serves to elevate the ash to a 40-ton bunker, delivers the coal to a 14-in. diameter screw conveyor that distributes the fuel to the boiler bunkers. Coal is crushed by a 24x20-in. rigid-hammer coal crusher.

The bulk of the current is produced by two 1,000-kw. condensing turbines. The low-pressure steam required by the rubber manufacturing processes is furnished through a 500-kw. turbine exhausting against 150 lb. back pressure. The amount of electric energy developed by this unit depends upon the amount of process steam used. An automatic governor, actuated by the pressure in the process steam line, controls the turbine load to meet the demand for low-pressure steam and maintain its pressure.

The rubber manufacturing processes also require steam at 200 lb. pressure. This steam is supplied by a compressor which raises the 150-lb. exhaust steam to the required 200 lb. per sq.in. The compressor operates on the injector principle, receiving half its steam supply at 375 lb. pressure and the remaining half at 150 lb. It is capable of delivering 5,000 lb. of steam an hour at 150 lb. pressure.

Steam from the two 1,000-kw. units is condensed in surface condensers each having 1,500 sq.ft. of cooling surface. Circulating water for these is cooled in an all-wood cooling tower with forced draft produced by two 10-ft. fans and circulated through the condensers by two 2,000-g.p.m. pumps. The tower can cool 216,000 gal. of water an hour.

In order to permit complete shutdown of the steam units over week-ends, a 150-kw. gasoline-engine generator set was installed. This unit is capable of furnishing sufficient energy to light the entire factory and to run one or two departments on Sunday load. It has also been of great service during several recent emergencies.

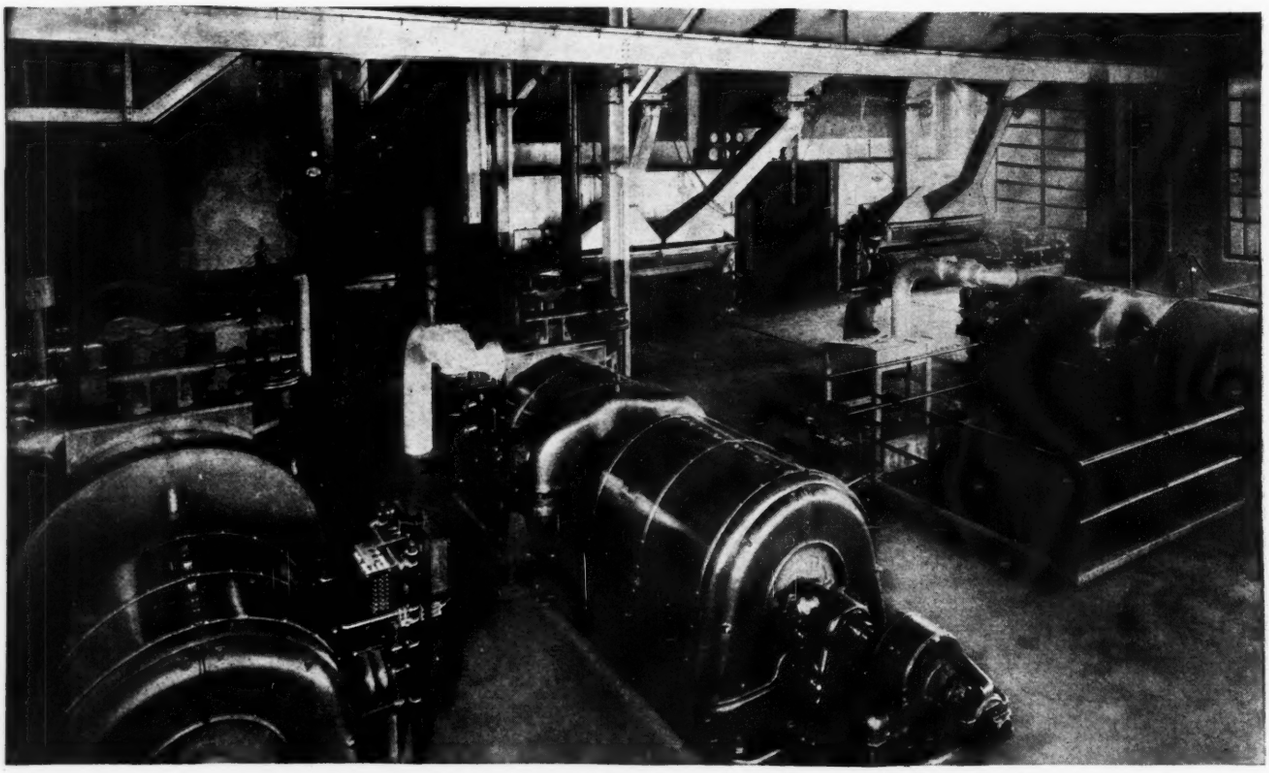


Fig. 2—View of turbine room showing boilers in the background

A unique feature of the plant is the absence of a separating wall between the boiler and the turbine rooms. This arrangement is clearly shown in Fig. 1 and in the photograph of the turbine room. It permits operation of the plant with a minimum operating crew.

The power-plant building is of brick, steel and reinforced-concrete construction. All construction below the operating floor is of reinforced-concrete, while above this level brick and steel is used. The turbine foundations are built integral with the building. The steel framework supporting the boilers also supports the roof. Cantilever construction is used for supporting the rear end of the boilers, making it possible to omit columns near the economizers.

The plant was designed by Wood & Weber, Inc., and built by the company.

Since the plans were decided upon, the load has grown materially. At the present time the production of power is over 1,000,000 kw.-hr. per month and the steam requirements have coincidently increased.

An interesting phase of the situation is that the cost of making power and steam in the new plant will be over $100,000 a year less than it would cost to purchase it from the central station. This will pay for the plant in less than five years.

Another interesting fact is that the cost of the plant was borne entirely by bonds issued by a subsidiary company, called the Gates Power Company, formed for the purpose of building the power plant. These bonds did not constitute an obligation against the Gates Rubber Company.

The bonds are being retired from the earnings, which are determined by the amount that would have been paid out to the power company had the plant not been built, the same amount of money being paid to the Gates Power Company as would have been paid to the Public Service Company. Thus the net result is that within a short time the plant will stand as an asset to the Gates Rubber Company without representing any capital investment. It can be said literally that the power plant has not cost the company one cent.

The plant has been in operation five or six months and has met every expectation of the designing and operating engineers.

PRINCIPAL EQUIPMENT, THE GATES RUBBER COMPANY

General

Location	Denver, Colorado
Generating capacity	2,650 kw.
Cranes	Two Armington Engineering Co.
Steam pressure	400 lb. per sq.in.
Superheat	250 deg. F.

Coal and Ash Handling Equipment

Concrete track hopper	Capacity 200 tons
Steel storage bin	Capacity 130 tons
Ash storage bin	Capacity 40 tons
Coal and ash drag chain conveyor, 24 in. wide	Jeffrey Mfg. Co. and E. C. Horne Machinery Co.
Rigid-hammer coal crusher, 24x20 in.	
Bucket elevator, with 16x8-in. buckets	
Spiral conveyor, 14-in. dia.	

Boiler and Combustion Equipment

Boilers, two cross-drum water-tube, 6,130 sq.ft.	Erie City Iron Works
Tandem blowoff valves	Yarnall Waring Co.
Copes feed-water regulators	Northern Equipment Co.
Safety valves	Crosby Steam Gage & Valve Co.
Internal steam purifiers	Schutte & Koerting Co.
Furnace arches, concave-convex type	M. H. Detrick Co.
Stokers, Green chain-grate, Type KM, size 11x15 ft., with water-cooled rear shaft	Combustion Engineering Corp.
Combustion control	Ruggles-Klingemann Mfg. Co.
Induced-draft fans, two, double width, double inlet, multivane fans, each can handle 46,000 cu.ft. of gas at 503 deg.	B. F. Sturtevant Co.
Economizers, two, 2,376 sq.ft. each, Type Y, high-pressure steel tube	B. F. Sturtevant Co.
Superheaters, two, Elesco, for 250 deg. superheat	Superheater Co.
Stacks, two, size 5 ft., dia. x 60 ft. high	The Eaton Metal Products Co.

Water Treatment and Pumping

Water softening, 26,000 lb. of makeup per hour	Neckar Water Softener Corp.
Feed-water heater, open deaerating type	Neckar Water Softener Corp.
Surge tank, 2,000 gal. capacity	Eaton Metal Products Co.
Boiler-feed pump, two, seven-stage, 125 g.p.m., 410 lb. pressure	Allis-Chalmers Mfg. Co.
Motor drive	General Electric Co.
Turbine drive	Moore Steam Turbine Corp..
Service pumps, two, 300 g.p.m., 75-ft. head, single-stage	Dayton-Dowd Co.

Generating Equipment

Turbine-generators, two, each 1,000 kw. at 0.8 power factor, direct-connected exciter; one, 500 kw. at 0.8 power factor. Turbine exhaust at 150 lb. back pressure	General Electric Co.
Generator air coolers, three	General Electric Co.
Casings by	Hardesty Mfg. Co.
Oil coolers, three	Schutte & Koerting Co.
Van Blerck gasoline-engine generator, 150 kw	Light Mfg. & Foundry Co.
Generator exciter and regulator	General Electric Co.
Motor-generator set, 200 kw., generator 300 kva., 0.8 power factor, synchronous motor	General Electric Co.
Motor-generator set, 200 kw.; generator, 750 kva.; 33.7 P.F. synchronous motor. Large motor used for power-factor correction	General Electric Co.

Condensing Equipment and Auxiliaries

Surface condensers, two, 1,500 sq.ft.	Elliott Co.
Steam-jet air ejectors, two, single-stage	Elliott Co.
Circulating pumps capacity, two, 2,000 g.p.m.	DeLaval Steam Turbine Co.
Condensate pumps, two, 40 g.p.m.	DeLaval Steam Turbine Co.
Cooling tower, all wood, forced draft	Foster Wheeler Corp.
Two 10-ft. fans, driven by a G.E. 40-hp. motor and Allis-Chalmers Texrope.	

Factory Auxiliaries (Located in Power Plant)

Thermo-compressor	Schutte & Koerting Co.
Laidlaw air compressor, two-stage motor-driven, 350 cu.ft. displacement at 300 r.p.m., 125 lb. pressure	Worthington Pump & Machinery Corp.
Steam-driven air compressor	Ingersoll-Rand Co.
Pump, motor-driven, hydracone centrifugal, two-stage, capacity 330 g.p.m., 200 lb. pressure	Allis-Chalmers Mfg. Co.
Pump, steam-driven, Duplex, capacity 600 g.p.m., 200 lb. pressure	Worthington Pump & Machinery Corp.
Pump, motor-driven, horizontal triplex, single-acting, capacity 100 g.p.m., 300 lb. pressure	Worthington Pump & Machinery Corp.
Pump, steam-driven, capacity 50 g.p.m., 300 lb. pressure	Union Steam Pump Co.
Pump, motor-driven, horizontal duplex, capacity 42½ g.p.m., 1,400 lb. pressure Allis-Chalmers Texrope drive	Worthington Pump & Machinery Corp.
Fire pump, capacity 1,000 g.p.m., 125-lb. pressure	Dayton-Dowd Co.

Piping and Valves

High-pressure steam piping	Midwest Piping & Supply Co.
Low-pressure steam piping	Crane Company
Boiler feed, blowoff piping and pipe bends for miscellaneous piping	Midwest Piping & Supply Co.
Circulating water and atmospheric exhaust piping	Hardesty Mfg. Co.
Gate, globe and check valves	Crane Co.
Pressure-reducing valves	Fisher Governor Co.
Atmospheric relief valves	Fisher Governor Co.
Temperature-regulating valves	American-Schaeffer & Budenberg Corp.
Desuperheaters, two	American-Schaeffer & Budenberg Corp.
Continuous blowoff control valves	Neckar Water Softener Corp.
Pipe covering	National Magnesia and Manufacturing Co. (Johns-Manville Corp.)

ELECTRIC ELEVATORS
Replace Hydraulics

By A. J. Diedrich
Chief Engineer
The Continental Building
Baltimore, Md.

IT HAS been said that the elevators are the heart of an office building. If this is true, then until somewhat more than a year ago the Continental Building, Baltimore, Maryland, was suffering severely from hardening of this vital organ. There was in this sixteen-story building a main bank of five hydraulic vertical cylinder machines, roped six-to-one, serving all sixteen floors. A seventh elevator served the safe deposit vaults on the basement and first floors, the bank on the second floor and offices on the third floor.

The best that could be said of this system was that it was faithful and willing but its flesh was weak. At the time of its installation it was without doubt the best type obtainable, but its period of usefulness, economically speaking, was about at an end. The maintenance costs were high and there was every evidence that they would be higher each succeeding year. The speed of the elevators was normally slow and decreased with load. The service obtained from the system as a whole was erratic and inadequate, particularly at rush-hour periods.

It was decided that in view of these conditions and the structural soundness and numerous advantages of the building, the expense of a new and up-to-date elevator system was economically justified.

It was thought that a modern elevator installation, with its greater speeds and heavier machinery, might produce strains that would overload the building columns. Despite assurance that the original columns were sufficiently strong to carry the additional burdens that would be imposed, new columns were installed from foundation to penthouse, designed to carry the entire load of the elevator system. Their only connection to the existing building columns is a bracing at each floor against a sidewise movement of the elevator structure.

The Continental Building

In a sixteen-story bank and office building, six hydraulic elevators were replaced by electrical equipment, with a resultant saving in operating cost of about 18 per cent and changed an inadequate service to one that is highly satisfactory. Four of the machines are of the signal-control micro-leveling type operating at 800 ft. per min. One, a service car, operates at 300 ft. per min.; a sixth is a low-rise machine for bank service. In the first year of operation the five high-rise cars traveled a total of 21,687 miles, making an average of 135 stops per mile on a power consumption of 5.22 kw.-hr. per car-mile.

Resting on these columns, a new penthouse of wired glass and steel was built, directly above the old penthouse, and all the new elevator machinery that was to go into it was installed before starting work on the elevators proper. The design of the penthouse was such that placing the machines could be done with no interruption to the existing service.

It was thought, after a study of the problem, that to provide a satisfactory elevator service, only four modern high-speed machines would be needed. This would make available hoistway for a service elevator. The correctness of this assumption was later borne out.

The service and bank elevators were the first installed, the object being to do as much of the preparatory work as possible before disturbing the main elevators. The remaining four elevators were changed over two at a time, thereby giving at least three cars to serve the building at all times. When a pair of elevators were taken out of service, the elevator contractor and the inclosure contractor worked on one of the two. This greatly facilitated construction, since the work of either contractor demanded the use of the entire hoistway.

The Otis Elevator Company's unit multi-voltage, micro-drive, signal-control machines were decided upon as best suiting the service needs. These machines operate at a speed of 800 ft. per min. This speed is attained after a rapid but uniform acceleration, which is barely noticeable while riding in the car. Full speed is reached within approximately fifteen feet of the starting point.

The inclosure doors and car gates are pneumatically operated, using Graham and Norton door-closers. Opening of both door and gate is done automatically, while closing is

done by means of the starting lever, in conjunction with a small motor beneath the car. A connection with the micro-leveling device from this door motor gives the automatic door-opening operation, which may be set for any desired distance from the landing level.

The old enclosure grilles were replaced by fireproof, hollow-metal partitions and doors, made and installed by the W. S. Tyler Company. This company also built and erected the solid bronze passenger cabs and the service and bank cabs, which are of enameled steel.

The service car has a speed of 300 ft. per min. and takes care of such work as freight, janitor and safe lifting. It is equipped with an annunciator system and is used during the night as a passenger elevator, as well as during the rush periods.

In replacing the elevator which served the four floors from basement to mezzanine, a push-button type machine was selected, operating at 100 ft. per min. This car is hand-operated by an attendant during banking hours, but after such time is operated by the passengers themselves, by means of automatic push-button control.

The high-rise machines are equipped with Veeder mileage recorders. The mileage on the bank-service machine, because of its comparatively infrequent use and low rise, does not exceed two miles a day on an average, making a mileage recorder unnecessary.

A watt-hour meter measures the power of all six elevator machines, and in addition includes the current used by the air compressors for the door closers.

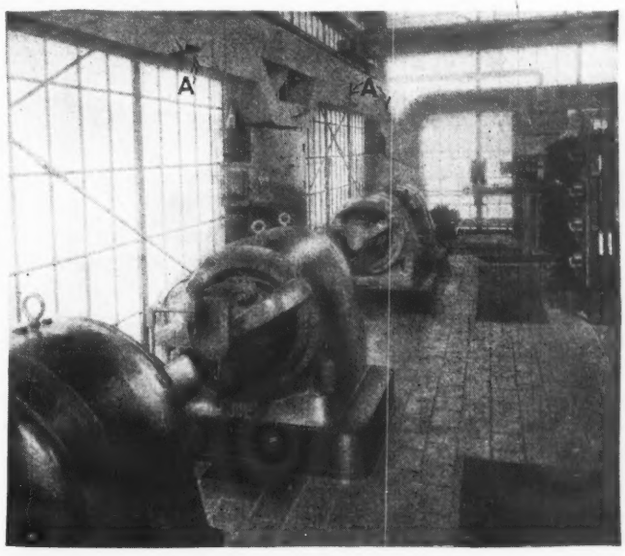
It is now possible to give operating figures on this elevator system for one complete year. The total recorded mileage on five cars is 21,687 miles, and including two miles per day for the bank elevator brings the car mileage to 22,417. The total power consumption on six cars for the corresponding period was 116,950 kw.-hr., an average of 5.22 kw.-hr. per car-mile for the year.

One factor to which may be attributed a considerable saving in current, as well as providing a convenient and methodical means of dispatching, is that the Boardman system of elevator control is used. This system, with its flexibility and ease of adjustment of schedules, aids materially in maintaining spacing of cars.

Another means of reducing to a minimum the power consumption is cooling the elevator machines in the penthouse by a forced blast from motor-blower. The air-blast is played directly on the machines by means of nozzles *A* in the duct, Figs. 1 and 2, and keeps the temperature of the machines low with a resultant low resistance of the windings and a better efficiency. The ventilators are by Theo. R. N. Gerdes, New York City.

Necessary repairs and renewal parts purchased for the complete system, including elevator machinery, cars, gates, doors, door-closers, etc., amounted to $498.86 for the year, of which, however, materials worth approximately $200 are at hand for spare parts. This is considered low in view of the fact that these elevators handle, in addition to the ordinary incoming and outgoing passengers, much more than the usual amount of internal traffic, due to the inter-floor activities of a number of large tenants. Car stops average 135 to the car-mile.

The cost of operation of the new elevator system, as compared with that of the old hydraulic elevators, shows approximately an 18 per cent reduction for the new system. This figure is arrived at after taking into consideration the decrease in coal purchased, a reduction in the fireroom payroll, the decreased cost for supplies, repairs and maintenance, as against the additional electric power purchased, an increase in operators' wages and the extra item of the elevator electrician's salary. This monetary saving is, of course, in addition to that intangible but important asset, "service."



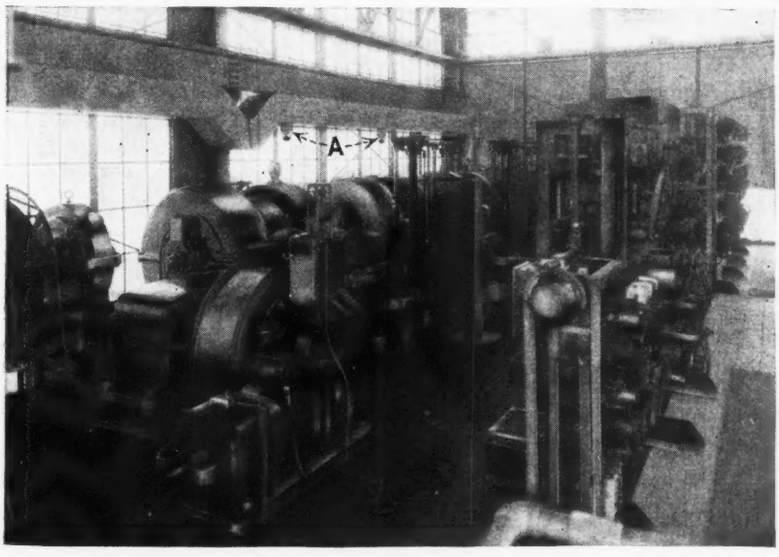
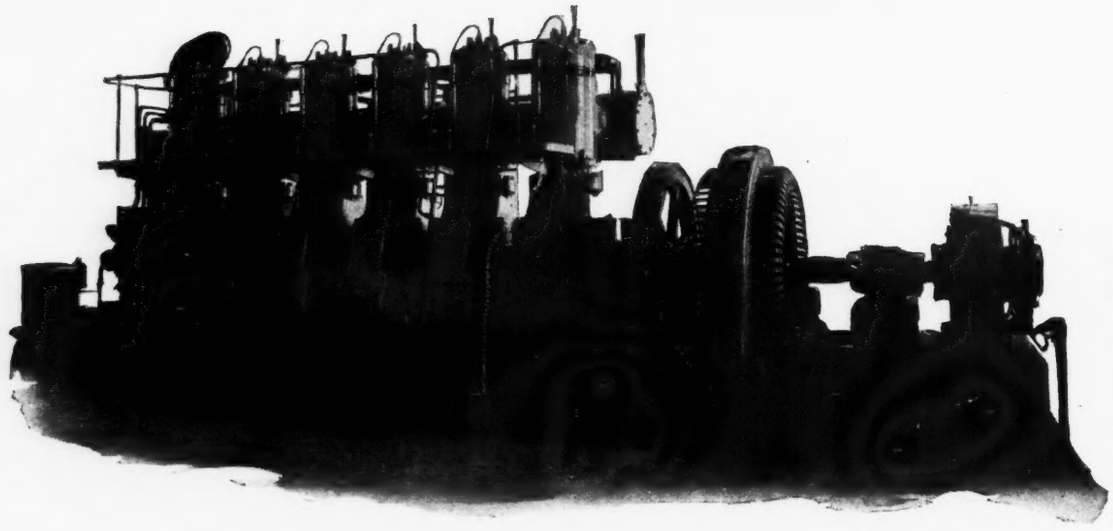


Fig. 1 (Above) — Motor-generator sets on the unit multi-voltage signal-controlled elevators

Fig. 2 (Left)—Micro-levelling elevator machines and control equipment

A machine room was constructed on the roof of the building and supported on steel columns independent of the building structure. This motor room is forced ventilated by a motor driven blower. The air ducts can be seen along the walls and the incoming air is directed onto the machines by the nozzles *A*.



Choosing Lubricating Oil
for a Diesel Engine

By J. W. Peterson

WHAT is good lubrication for an oil engine? Good lubrication may be defined as the proper oil, in the proper place, in the proper amount and at the proper time.

This definition holds true for the lubrication of a Diesel engine as well as that of any other kind of machinery, but it does not contain all the information desired by the engineer. He wishes to know more regarding the practical side of lubrication as it pertains to the type of engines in his own plant.

The question arises as to where this practical information can be obtained. The engine-builder's manuals may be suggested as one source of information. These manuals contain valuable information, but the engineer who has really interested himself in lubrication knows that the manuals touch on the subject of lubrication only in a general manner. One engine builder's manual reads: "The amount of lubricating oil fed to the cylinders should not be more than necessary to lubricate them. The proper amount of oil will depend a great deal on how much work the machine is doing, so no definite quantity can be specified. The safest way is to examine the cylinders occasionally and to judge from their condition whether more or less oil is required."

This does not contain definite information, one must admit. However, the author of the paragraph appreciated the important fact that the operating conditions in one plant may be far different from those in another plant. Difference in power load, mechanical condition of the engine and kind of lubricating oil will vary the oil consumption.

The builders' engineers realize that it is impractical to specify a certain viscosity oil for all their engines because each engine will operate under different conditions. This being the case, the responsibility falls on the operating engineer to determine the best oil for his engines running under local operating condition.

This determination is not very difficult if the engineer will devote a little time to making some test runs. To begin, the engineer should make up a record sheet including the following items: The bearing clearances; the diameters of the cylinders parallel to the crankshaft at the top; the diameters of the cylinders at right angles to the crankshaft at the top; the diameters of the cylinders parallel to the crankshaft at the bottom, and the diameters of the cylinders at right angles to the crankshaft at the bottom.

In addition he should note the condition of rings; the number of rings stuck and partly stuck; the amount of carbon in the exhaust ports, exhaust manifolds and the amount of carbon on the exhaust valves, on the cylinder head and on the top of the piston.

The engineer may ask, "How much wear should one expect to find?" That question can be answered only in a very general way, because wear depends on the kind of engine and the operating conditions. For instance, if an engine is run sixteen hours a day at full load, surely one will expect greater wear than if that same engine is run only fourteen hours a day at half load. Other operating conditions that affect the amount of wear are temperatures of inlet and outlet cooling water, temperature of exhaust gases, the amount of scale

on the water-jacket walls, the reclaiming process used on the oil and the quality of the fuel oil.

Suppose an engineer was ready to start a new two-stroke-cycle Diesel, but had not decided upon what oil to use. First, it would be advisable for him to look over the list of recommended oils or the specifications of the proper oils as contained in the engine builder's manual. It would not be out of order for him to call in engineers from two or three reputable oil companies and receive their arguments. He should inspect every similar engine in the neighborhood. One must make sure that the neighbor engineer's suggestions and recommendations are based on actual experience and not on personal opinion.

Viscosity More Important Than Flash Test

A few years ago many engineers were of the opinion that the flash point was the all-important test. Today the majority of the engineers inquire as to the viscosity of the oil, because they have learned that the viscosity test is more important. This test is made with an apparatus known as a viscosimeter, shown in many textbooks.

The viscosity of an oil is a relative measure of its resistance to flow, its internal friction, and is inversely proportional to its fluidity. A high viscosity oil is thick and flows with difficulty; a low viscosity oil is thin and flows readily. The viscosity is determined by measuring the time in seconds for 60 c.c. of oil at a specified temperature to flow out through a vertical tube that forms part of the viscosimeter.

Light and medium oils are tested at 100 deg. F. Heavy oils are heated to 210 deg. F. when tested for viscosity, in order to decrease the time required to make the test and also to increase the accuracy of the test.

All oils become more fluid with an increase in temperature. Oils refined from naphthenic crudes show a greater fluidity with an increase in temperature than oils made from Eastern crudes. This fact is important because we should be more interested in the viscosity at the normal operating temperatures than in the viscosity at 100 deg. F.

The first check to make after the engine has been properly worn in, is to find whether or not the piston and cylinder are receiving the correct amount of lubricating oil. This is done by removing one of the exhaust manifold plates and inspecting the top ring.

Checking the Carbon

The amount of accumulated carbon in the exhaust ports and manifold should be checked at the same time. It may be necessary to clean out the exhaust ports once every two weeks or maybe only once in six months. This difference in the amount of carbon formed may be due either to the lubricating oil, the fuel oil or to operating conditions. If a relatively small amount of carbon is formed, you may chalk up one point in favor of the oil being used.

If the engine is run steadily under a heavy load, it may be advisable to pull the pistons following six months of operation. The same measurements should then be made as were made on the engine before it was started. The condition of the rings, pistons and cylinders should be recorded. The output and the fuel consumption should be obtained from the daily log sheet and the output per gallon of fuel oil calculated. The output per gallon of lubricating oil should be calculated in the same manner. This test run could well be extended for another six months in order to get a more accurate check on the wear of the engine.

Before changing to another oil, the crankcase and oil pipes should be thoroughly cleaned.

Following six months' operation with the second oil, the piston should again be pulled. The measurements and condition of the engine should be recorded as before.

The following records should be compared: Wear; time intervals between cleaning out carbon; output per gallon of lubricating oil; output per gallon of fuel oil, and the average load if there has been a change.

Such a comparison will leave little doubt as to which is the more satisfactory oil for that particular engine running under the local conditions.

How a Change of Oil Increased Efficiency in One Plant

I know an engineer who had been using one particular oil for eight years. He was satisfied that he was using one of the best oils obtainable, because its price was high and it had the reputation of being a high-quality oil. However, it was pointed out to him that he was not using an oil of sufficient viscosity for his engines in their present condition. The liners were badly worn. The top rings were slightly worn, but were not stuck in their grooves. The liners were coated with scale as the result of using hard city water for cooling when the rain water was low in the reservoir. This scale naturally caused abnormal cylinder wall temperatures, which in turn resulted in a thinner oil between the pistons and the cylinders than under normal conditions. The cylinder wall temperatures could not be lowered appreciably by an increase in cooling water because the water was coming into the engines at 94 to 101 deg F. and leaving at 110 to 115 deg.

The reasoning appeared logical to the engineer, so he changed to a higher-viscosity oil for cylinder lubrication. The first noticeable result appeared on the daily log sheet. The average kilowatt-hour output per gallon of fuel oil for five days preceding the change in oils was 8.65. A month later the average output per gallon of fuel oil for five days was 9.85. During the month the average load had increased slightly, so this would cause an increase in efficiency. However, the main increase in output per gallon of fuel oil must have been due to the greater sealing property of a heavier oil.

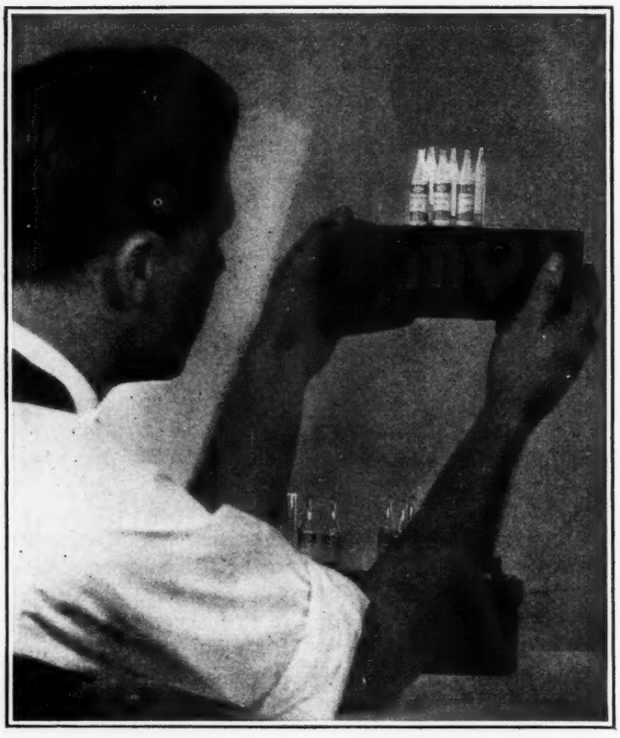
A second noticeable result was in the better operation of the engine during peak loads.

These statements are not to be construed as meaning that a heavier oil corrected the worn condition of the liners and eliminated the effect of the scale. The heavier oil only effected a better seal than had existed. The engineer expects to install new pistons, new cylinders and a water softener next spring. After that a high-quality oil of a lower viscosity should prove satisfactory.

Looking Back Over 1928

What the last 12 months has meant in power plant progress and in business to the equipment manufacturer, will be reviewed in

January 1 Issue



STOPPING CORROSION

by Hydrogen-Ion Control

By F. R. McCrumb

Chief Chemist, The LaMotte Chemical Products Company

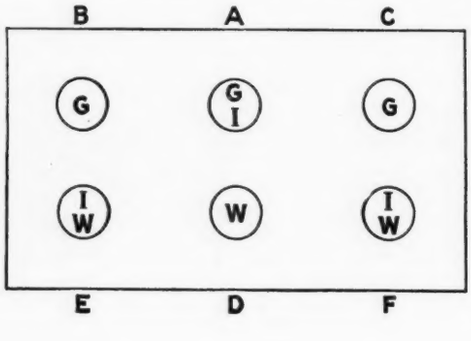
THE economic losses and operating difficulties that are frequently encountered in refrigerating systems, due to the corrosive action of the freezing brine, are factors of prime importance in ice manufacture and in every industrial process where such brines are used. Controlling the hydrogen-ion percentage will help to overcome these losses and difficulties and will be of considerable value.

Before corrosive action can be retarded, the factors causing such action must be known. While it is probable that there are some corrosive forces not entirely revealed, many are known and methods of controlling them have been developed. The outstanding factors effecting brine corrosion in refrigerating systems have been found to be the alkalinity of the brine, the dissolved oxygen content, the concentration of the brine, the impurities present and the design and construction of the system.

The one factor of prime importance in all cases is the alkalinity of the brine.

Before discussing the importance of alkalinity in brines, it will be advantageous to explain briefly the modern method of expressing degrees of acidity and alkalinity. The use of litmus paper has heretofore been the most common method of testing solutions for acidity or alkalinity. This paper contains a dyestuff which is red in acid and blue in alkaline solutions. If the paper is faintly red on immersion in a solution, the solution is said to be slightly acid; if faintly blue, the solution is taken to be slightly alkaline, but if the paper is deep blue, the solution is called strongly alkaline. It can readily be seen that such a method is only approximate. In order to secure accurate control of the acidity or alkalinity, the plan must be placed on a quantitative basis. This has been done, and instead of vague and indefinite terms, like "slightly acid" or "strongly alkaline," definite values are substituted, which can be recorded and duplicated at any time. Such a set of values constitutes a quantitative scale of acidity and alkalinity.

Fig. 1—Arrangement of test tubes



A scale that is most familiar is that of temperature, as shown by the Fahrenheit thermometer. Let

us suppose that the values above 32 deg. F. on the scale represent degrees of heat and those below 32 deg. represent degrees of coldness. Then values above 32 deg. such as 35, 40 and 50 deg., will denote increasing heat as the values increase. Values below 32 deg. such as 25, 20 and 10 deg., will denote increasing coldness as the values decrease.

In a similar manner the degree of acidity or alkalinity of a solution is expressed by a scale known as the hydrogen-ion scale. The units on this scale are called *pH* values instead of degrees Fahrenheit. On the hydrogen-ion, or *pH*, scale a value of 7.0 represents exact neutrality; that is, a solution with a *pH* of 7.0 is neither acid nor alkaline.

What *pH* Values Mean

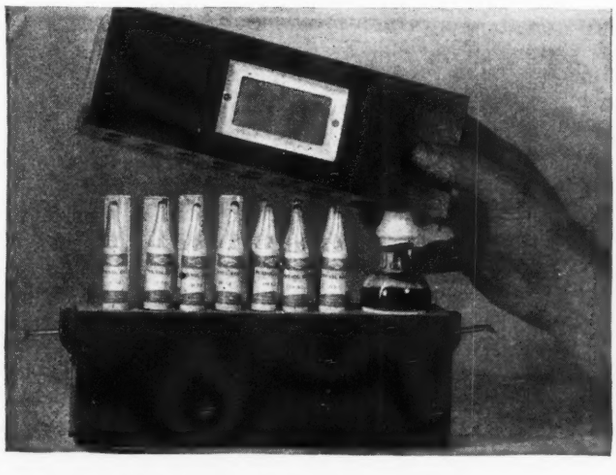
Following the thermometer illustration, any values higher than *pH* 7.0, such as 7.2, 7.4, 8.0, 9.0 and 10.0, denote alkalinity, the degree of alkalinity increasing as the numbers increase. Values lower than *pH* 7.0, such as 6.8, 6.6, 6.0 and 4.0 denote acidity, the degree of acidity increasing as the numbers decrease. Thus solutions of acids tend to have low *pH* values, and solutions of alkalies tend to have high *pH* values.

Take, for example, a brine at *pH* 8.0. If acid is added, the *pH* will drop to 7.5, 7.0, 6.0 or even 5.0, and the decrease will depend upon the amount of acid added. If alkali is added, the *pH* will rise and the increase will depend upon the amount of alkali added.

For practical purposes a *pH* value can simply be regarded as a number denoting the degree of acidity or alkalinity of a brine, and an operator will soon learn to use this term just as he does the term "degrees Fahrenheit." It is apparent that one can make accurate temperature readings without knowing the derivation of the scale. Similarly, a knowledge of the derivation of the term *pH* is not essential, in order to use the method for measuring acidity or alkalinity.

All ice-plant operators are more or less familiar with the use of phenolphthalein. Usually, when a brine is tested with this indicator, if no color results, the brine is considered acid or neutral; if a faint red color results, the brine is taken to be slightly alkaline and a deep red indicates a fairly alkaline brine. Strictly speaking, a brine that gives no color with phenolphthalein, need be neither acid nor neutral. Phenolphthalein is colorless at or below 8.2 and deep red at or above 10.0. It can now be seen that a brine may have a *pH* as high as 8.0 and still give no noticeable color with this indicator.

Fig. 2—A hydrogen-ion test set



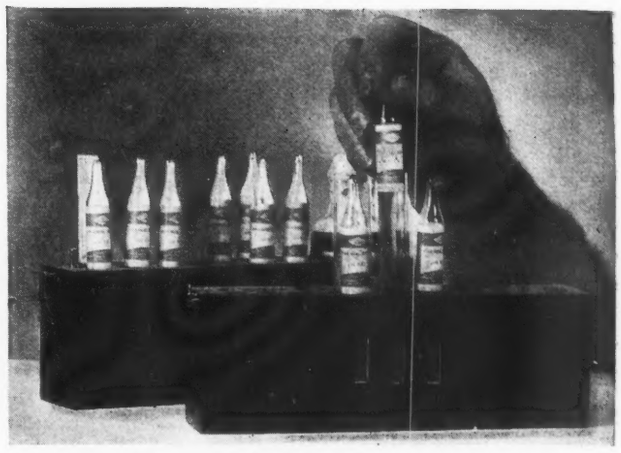


Fig. 3—Preparing a test

There are a number of dyes that give more pronounced and stable color changes than does phenolphthalein. Since these undergo color changes at different points on the *pH* scale, it is possible by the use of a series of such dyes to make *pH* measurements at any point on the scale. However, in controlling the alkalinity of brines, the only ones of particular interest are those which undergo change between *pH* 6.0 and *pH* 10.0. These, together with their *pH* ranges and color changes, are:

Indicator	*pH* Range	Color Change
Bromthymol blue	6.0–7.6	Yellow to blue
Phenol red	6.8–8.4	Yellow to red
Cresol red	7.2–8.8	Yellow to red
Thymol blue	8.0–9.6	Yellow to blue

In the case of the indicator phenol red, it will give a yellow color in a brine having a *pH* of 6.8 or under and a red color in a brine having a *pH* of 8.4 or over. Between 6.8 and 8.4 it will give colors varying progressively from yellow to red. A series of accurate color standards can be prepared covering the *pH* range 6.8 to 8.4 in suitable intervals, preferably 0.2. Such a series for phenol red consists of color standards for 6.8, 7.0, 7.2, 7.4, 7.6, 7.8, 8.0, 8.2 and 8.4. These are prepared to contain definite amounts of indicator. If a measured sample of clear brine is treated with the same amount of indicator as is present in the standard, the resulting color will depend upon the *pH* of the brine, and by comparing this color with the color standards, the exact *pH* can be determined.

Using a Comparator

Many brines are colored or turbid, so it is advisable to employ some form of comparator in making comparisons. Comparators are of various types, but the actual method employed is similar to that used with the block type shown in the headpiece. This comparator contains a series of six holes connected in pairs by slots which pass entirely through the block. This arrangement can be illustrated as in Fig. 1. The other openings are made to accommodate test tubes when the block is used as the cover of the case, Fig. 2.

Three test tubes preferably graduated to hold 10 c.c. are filled with the brine to be tested and placed in the holes marked *B*, *A* and *C*. A measured amount of a standardized indicator solution, say 0.5 c.c. of 0.02 per cent phenol red, is added to the middle tube *A*, and the contents are well mixed. A tube of distilled water is placed in the hole marked *D*, and two color standards, differing by only 0.2 *pH*—for example, 8.0 and 8.2—in the two holes *E* and *F*. The block is then held toward

a window or some source of daylight, and the color standards are changed if necessary until the central pair of tubes exactly matches one of the other pairs, or until the color through the central pair lies between the colors of the pairs on either side. One should always be sure that the standards in the block differ only by 0.2 *pH*, that is, 7.8, 8.0, 8.2, etc. If an exact match is obtained, the *pH* of the brine is read off directly from the standard with which the match is obtained. If, however, the color of the central pair of tubes lies between the colors of the pairs on either side, the *pH* value is taken as the average of the two. For example, if it lies between 8.0 and 8.2, the value is taken as 8.1.

If a piece of etched glass is placed over the slots on one side, as is the case of the block in Fig. 2, and the block held so that the glass is on the side facing the light, it is easier to make comparisons, since shadows are eliminated.

The reason for the special arrangement of tubes is to eliminate the effects of color and turbidity. Fig. 1, in which the unknown solution is designated as *G*, water as *W* and the indicator as *I*, will illustrate how this is accomplished.

This arrangement shows that any pair of tubes contains the same color constituents; namely, *G*, *I* and *W*. A solution already colored or turbid cannot be compared directly with a color standard, but when such comparison is made by observing the color standard through a layer of the colored or turbid solution, reliable comparisons can be made. The tube of distilled water merely serves to maintain the same thickness of liquid.

The use of each of the indicators is similar to the use of phenol red, except that each covers a different range on the *pH* scale. While the necessary color standards can be prepared, it requires a somewhat special knowledge of the subject, and it is more convenient to purchase such standards; in fact, complete equipment for making *pH* determinations by this method is easily available at a nominal cost.

Brines that are neutral or acid—that is, have a *pH* of 7.0 or less—attack practically all the metals used. When the *pH* is too high, zinc, brass and bronze are attacked, although iron and steel really undergo less corrosion, unless the *pH* becomes quite high, 12.0 or above, when pitting may take place. The best practice is to maintain a *pH* of about 8.0, if protection of all the parts is desired. In systems in which the galvanizing is already gone, protection of the iron and steel can be furthered by holding the brine at about *pH* 9.0. By referring to the indicators it will be seen that either phenol red or cresol red is satisfactory in the first case, while thymol blue covers the second case.

In case a determination shows that the *pH* of the brine is too low, alkali must be added and either caustic soda or hydrated lime can be used. If the *pH* is too high, acid is required. Hydrochloric acid, sulphuric acid or carbon dioxide will serve to reduce the *pH*. Carbon dioxide is probably the safest reagent to use, since there is less chance of adding an excess. In addition, this encourages the formation of a protective coating of basic zinc carbonate on the galvanized parts. All corrective chemicals should be applied at a point in the agitator trough just preceding the passage of the brine through the agitator. Strong acids may be added in concentrated form, while carbon dioxide may be run in by means of a pipe leading directly from the cylinder. Caustic soda may be introduced as a concentrated solution and lime as a slurry. Suspension of a bag of these alkalies in the agitation trough is sometimes recommended, but in the case of calcium brines an extremely insoluble compound may be formed in the meshes of the bag and thus cause difficulty.

In adding acid or alkali to the brine, care should be taken not to add too much. The best practice is to add a little at a time and then redetermine the *pH* after several hours to note the effect. In adding carbon dioxide the *pH* can be determined from time to time, as the gas is being absorbed and the addition stopped when the proper value is reached. Once the alkalinity of a brine has been adjusted, it will, except in the case of fresh brines, require little attention, but a check should be made about once a week to make sure that no appreciable change has occurred.

Setting Poles with Dynamite

WHAT would you think if you happened along in time to see a line construction gang go through the silly act of standing a 50-ft. pole on end on the surface of the ground and then to see the men stand back with rope guys and wait as if they expected someone to come along with a 100-lb. hammer and drive the pole to its required depth? But how your curiosity would turn to awe when you felt a slight earth rumble and witnessed the pole slide gently into the ground to a depth of 10 or 12 feet.

This is an everyday occurrence in Florida. The method of setting power and telephone line poles with dynamite has been developed into an art, according to F. F. Johnson in the *O. B. Bulletin.*

The story goes that several years ago a laborer in a gang erecting poles in the soft soil of Florida, professed that he had been a "powder monkey" by trade and asked the foreman to give him a chance to blow a couple of holes in the soft ground and then see if they could not jam a pole into the hole before it caved. This method worked out fairly well except when the hole caved too soon or the pole when once down came popping out as though it had hit a powerful spring.

The foreman began to wonder just how high in the air a pole would go if stood on end over the powder hole before a blast. He let his curiosity get the better of his judgment and when the "joke shot" responded to the electrical current from the battery the pole did not go rocketing skyward, but instead, quivered once and then settled into the ground without the flying of dirt as from the previous blasts.

With this start a study of the use of explosives in pole erection has led up to its present state of efficiency in soil conditions comparable to those in Florida.

The Florida Power & Light Company uses the method for swamp land. At the pole location, a 1½-inch pipe is worked into the ground by employing the use of a ½-inch rod for a plunger inside the pipe. With this agitation at the point of piercing, the pipe is easily pushed downward by the weight of two men applied on Stilson wrenches at opposite sides of the pipe. The pipe is forced to a depth representing the depth desired to set the pole, the plunger rod is removed, and several sticks of dynamite are dropped into the pipe and pushed to the bottom. The inertia of the pole at the instant of explosion tends to prevent an upward movement and what little ground disturbance takes place is seen around the pole. As the pole slides into place, gases from the shot leak out between the soil and the circumference of the pole. This pressure would indicate that the confined gases tend to retain the pocket walls awaiting the pole.

NEW BOILER PLANT

of Illinois Glass Company

Designed For Future Extensions

By A. J. Tigges
Jackson & Moreland

THE boiler plant recently completed to supply industrial steam for the Illinois Glass Company's plant at Gas City, Indiana, replaces a hand-fired installation that increased steam demand had made inadequate. The new plant, containing many modern features, is expected to supply future steam requirements, and at reduced cost.

The present load is 23,000 lb. of saturated steam per hour at 150 lb. per sq.in. gage. The bulk of this steam is delivered to reciprocating steam-driven air compressors and vacuum pumps. The rest is used for gas producers and less significant processes. The load is nearly constant during any particular season and drops off very little on Sundays and holidays. The exhaust steam from the reciprocating machines supplies the heating system for the whole plant. The winter load is therefore slightly greater than the summer load because of the increased back pressure which is necessary for the heating system.

The entire plant is designed to permit operation at a steam pressure of 200 lb. per sq.in. gage with a superheat of 100 deg. F. This will accommodate the possible use of a steam turbine at reasonable economy in case it is so desired. For the present, however, the plant will be operated at 150 lb. pressure with no superheat. It is expected that one 4,890-sq.ft. boiler will carry the present load with the second boiler as a stand-by unit.

Provision for Future Growth

The plant is so designed that a third boiler may be added on the east side. This would allow continuous operation of two boilers with one stand-by unit. The chimney has a blanked off opening to accommodate such an extension. Either one of the present forced-draft fans will carry two of the boilers fully loaded. The steam and feed-water systems are also designed to accommodate such an extension.

The water-softening system has sufficient capacity to supply the makeup requirements of two boilers fully loaded, provided the load includes a 1,000-kw. condensing turbine. It is probable that a third boiler-feed pump will be added with the third boiler. The coal- and ash-handling system is now designed to take care of such future extensions, with the possible exception of the extension of the ash drag conveyor and screw conveyor over the coal bunker. The bunker may be increased, if desired.

If more capacity is required before the third boiler is added, economizers and induced-draft fans may be installed above the boilers, as space has been allowed for this and the steel designed to carry these additional loads. Future increase of fuel prices may warrant the installation of this equipment for the sake of improved efficiency alone.

The feed-water supply, which contains a great deal of hardness, is obtained from deep wells. Of the several methods of treating this water for boiler-feed purposes, the hot-process system proved to be the most desirable. Very little condensate is being returned from the present power system, and therefore nearly all the boiler feed water must be softened and heated. There is plenty of exhaust steam available, both winter and summer, therefore the feed-water temperature is limited to a maximum allowable back pressure in the softener system of 3½ lb. gage. Any higher pressure in the softening plant would tend to hold back the natural flow of the water from the raw-water storage tank on the roof.

The temperature of the water in the softening plant will vary between 210 and 220 deg. F. This is within the range of temperatures for good chemical reaction and good operating temperatures for boiler feed water.

The water conditions required the softening to be done by commercial 58 per cent soda ash and hydrated lime containing not less than 90 per cent calcium hydroxide.

With these conditions automatic control can well be justified, and, therefore, there was installed a complete combustion control system for both boilers, boiler feed-water regulators, and excess-pressure governors on the boiler feed pumps.

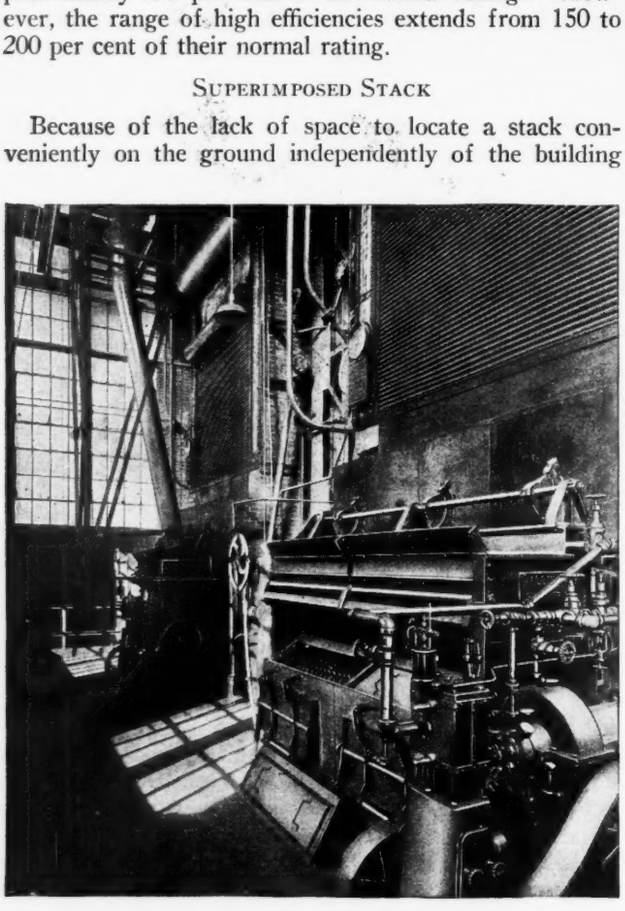
The furnace pressure controls the windbox damper between the stokers and the forced-draft fan. By means

of a mercury-type master regulator, the steam pressure in the header controls the uptake damper, stoker engine speed, and forced-draft fan speed.

In the light of the present load and the possible future growth it was decided to design these boiler units to operate at their highest efficiency when delivering approximately 175 per cent of the normal ratings. However, the range of high efficiencies extends from 150 to 200 per cent of their normal rating.

Superimposed Stack

Because of the lack of space to locate a stack conveniently on the ground independently of the building and because it proved to be more economical, the stack was superimposed upon the building steel.



Boiler aisle, showing chain-grate stokers

Tunnel under boilers where ash conveyor is located

The steel that supports the coal bunker, building, boilers, heater platform and raw-water storage tank, is all tied into the steel that directly supports the stack. The stack weighs 280 tons, and the top is approximately 219 ft. above the firing floor. It has an inside diameter at the top of six feet.

In deciding on the type of stack to be used for this job, three kinds were considered—steel, concrete, and radial brick. It did not seem to be desirable to use concrete in connection with the probable high flue-gas temperatures associated with high ratings on the boilers, and a radial-brick stack was selected.

In order to cut down the size of the building to a minimum, the firing aisle was limited to good operating space. There are large doors installed in the front of the building to allow the tubes to be withdrawn from the boilers.

The raw-water tank, screw conveyor over the bunker, and bucket elevator were all housed in by asbestos-pro-

PRINCIPAL EQUIPMENT OF NEW BOILER PLANT OF ILLINOIS GLASS COMPANY

Item	Type	Quantity	Capacity	Maker
Boilers	Cross-drum horizontal water-tube	2	4,890 sq.ft., 200 lb. per sq.-in. steam pressure	Edge Moor Iron Co.
Stokers	Forced-draft chain grate	2	130 sq.ft.	Illinois Stoker Co.
Fans	Forced-draft silent vane electrically driven	1	24,000 cu.ft. per min. with 3-in.-pressure	B. F. Sturtevant Co.
	Steam-driven	1		
Boiler feed pumps	Electrically driven triplex	1	100 g.p.m.	Worthington Pump & Machinery Corp.
	Steam-driven duplex	1	100 g.p.m.	Hayes Pump & Machinery Corp.
Chimney	Superimposed radial brick	1	171 ft. above roof and 6 ft. inside diameter at top	Alphons Custodis Chimney Const. Co.
Breeching	Steel plate	2		Superior Body Corporation
Coal- and ash-handling equipment	Conveyor and elevator type	1	40 tons per hour of coal and 20 tons per hour of ash	Stearns Conveyor Co.
Water treating and heating system	Hot process for using soda ash and lime	1	100 g.p.m.	Cochrane Corporation
Piping materials				Crane Company
Piping installation				Lord Electric Co.
Piping materials				National Valve Foundry & Const. Co.
Boiler blow-down tank	Centrifugal receiving nozzle type	1	For 200 lb. pressure	Superior Body Corp.
Raw-water storage tank	Open-top cylindrical	1	8,500 gallons	Superior Body Corp.
Asbestos-protected metal for pent-house	Mansard	37 squares		H. H. Robertson & Co.
Structural steel		110 tons		Indiana Bridge Co.
Reinforcing steel				Truscon Steel Co.
Boiler settings	Flexible wall construction	2		John V. Boland Const. Co.
Refractories				A. P. Green Fire Brick Co.
Combustion control	Mercury master control and bell type of gasometer	1 master control 2 gasometers		Carrick Engineering Co.
Feed-water regulation	Thermostatic, Copes	2		Northern Equipment Co.
Boiler-feed pump governors	Pressure type, Copes	2		Northern Equipment Co.
Soot blowers	Valve in head	2 sets of 5 units each		Diamond Power Specialty Corp.
Non-return valves	Lagonda	2	8 inch	Elliott Co.
Coal reclaiming drag scraper system		1	40 tons per hour	Sauerman Brothers
Meters	Bailey boiler meters	2	50,000 lb. steam per hour	Bailey Meter Co.
Draft gages	Multi-pointer	2		Bailey Meter Co.

rected metal-covered penthouses superimposed on the building roof.

The space at the rear of the boilers was cut down to the minimum amount necessary to accommodate the fans and feed pumps on the firing floor, and the hot-process softening system on the heater platform. This scheme was carried out to the point where doors had to be provided at both ends of the passageway behind the boilers on the firing floor and at the west end of the heater platform, to make it possible to remove equipment from the building for repairs. Good operating space was allowed between the two boilers and between the boilers and building walls.

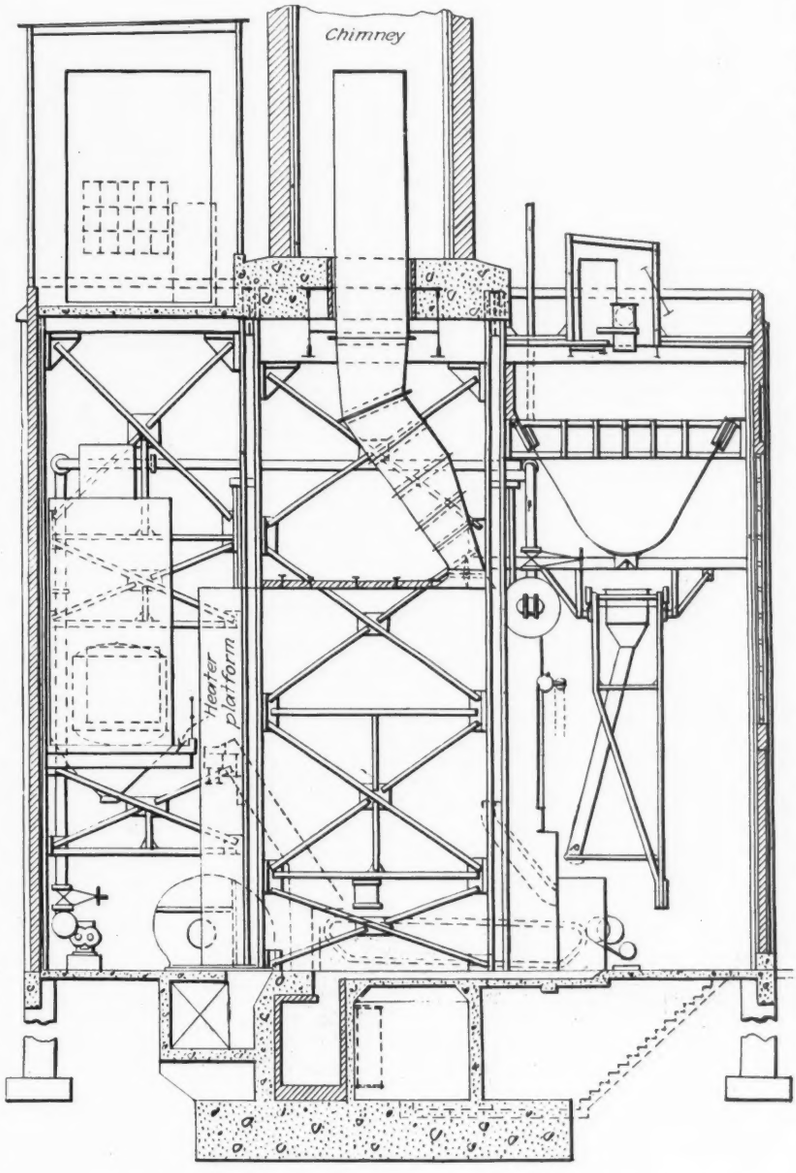
All this resulted in a comparatively high boiler capacity per unit area of ground covered. There is but 0.25 sq.ft. of floor area allotted to each square foot of boiler-heating surface.

Eight-inch red-brick curtain walls were built to inclose the building and were supported and reinforced at intervals by structural steel. This proved to be economical because of a saving of material. It required as much labor to install this type of wall as would have been required by a 12-in. wall. The walls have shown no signs of leaks due to driving rains.

The plant is designed to use a Mid-Western bituminous coal such as Indiana run of mine. This fuel contains high quantities of ash, from 12 to 17 per cent. It is free-burning coal and must be well moistened to burn properly on the chain grates. The sulphur content of the coal varies from 3 to 5 per cent, and contains a great deal of iron oxide, all of which means that there is a low ash fusion point which causes it to slag easily. Some of the samples of the ash fused at approximately 2,100 deg. F. The B.t.u. content of the coal as fired, averages about 11,500 per pound.

Such fuel conditions made it desirable in this case to install chain-grate stokers. Furthermore, the furnace had to have special construction and provision to prevent slag from adhering to the side walls. Water-cooled elements were placed at the fire line with carborundum brick built on top of them three courses high. Above this was built the regular firebrick wall made of very dense refractories.

In order to reduce the coal- and ash-handling equipment to a minimum, it was combined; that is, the bucket elevator was used to elevate the ash from the ash tunnel and the coal from the bottom of the track hopper. The coal-handling equipment is designed to deliver 40 tons of coal an hour to the boiler bunkers and will remove 20 tons of ash an hour from the ashpits.



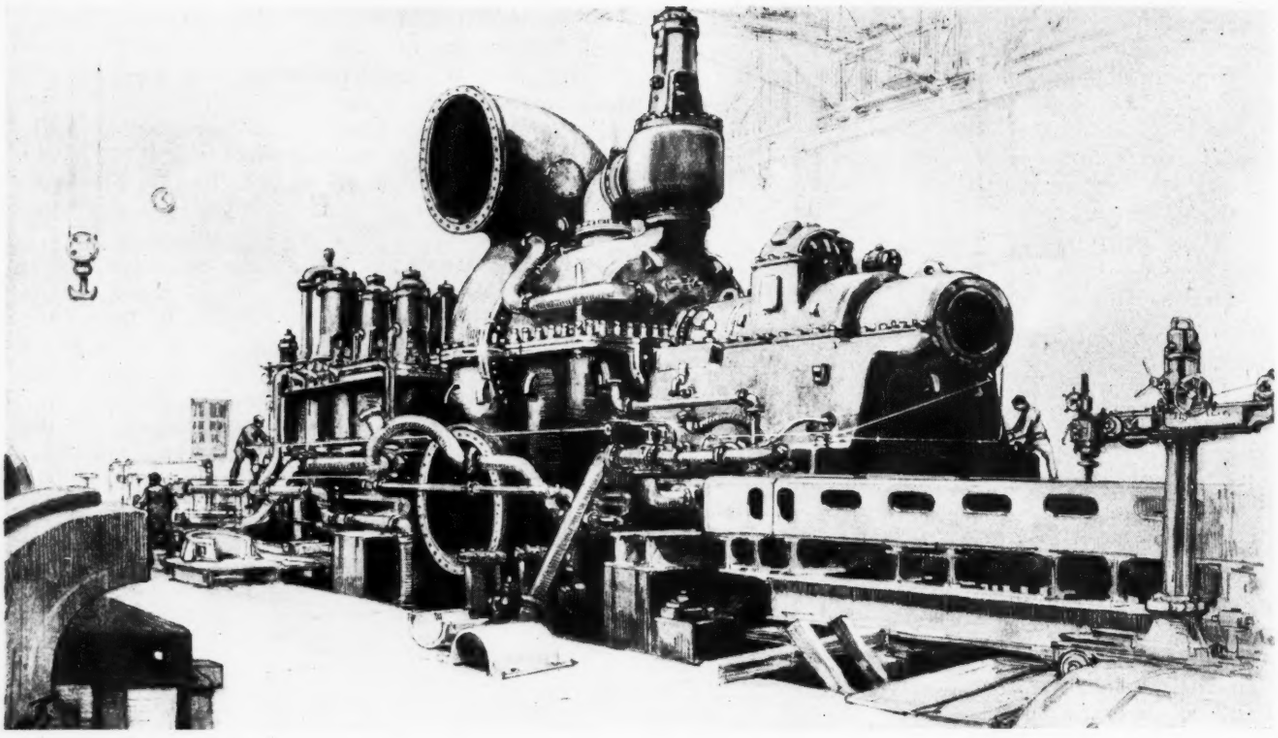
Sectional elevation of boiler room in the Gas City plant of the Illinois Glass Company

External to the boiler plant is provided 1,200 tons of coal storage which can be handled rapidly by machinery. A power scraper is used to drag the coal from the storage to the track hopper serving the boiler-plant coal system, and, vice versa, the scraper will carry the coal from the boiler plant system to the yard storage. Between the track hopper and bucket elevator there is a crusher and system is provided for bypassing it.

The job was started March 9, 1926, and the entire load was taken on boiler No. 1, Jan. 30, 1927, and the load has been held continuously since then.

The engineering, supervision of construction and building program were handled by Jackson & Moreland, Engineers, Boston, Massachusetts.

A person's feeling of warmth is not due alone to the temperature of the surrounding air as registered by a dry-bulb thermometer, nor does it depend solely upon the temperature indicated by a wet-bulb thermometer. Dry air at a relatively high temperature may feel cooler than air of considerably lower temperature with high moisture content. Air motion makes any moderate condition feel cooler. Human comfort depends largely upon the body temperature and, therefore, upon the relation between the rate of production and dissipation of heat.



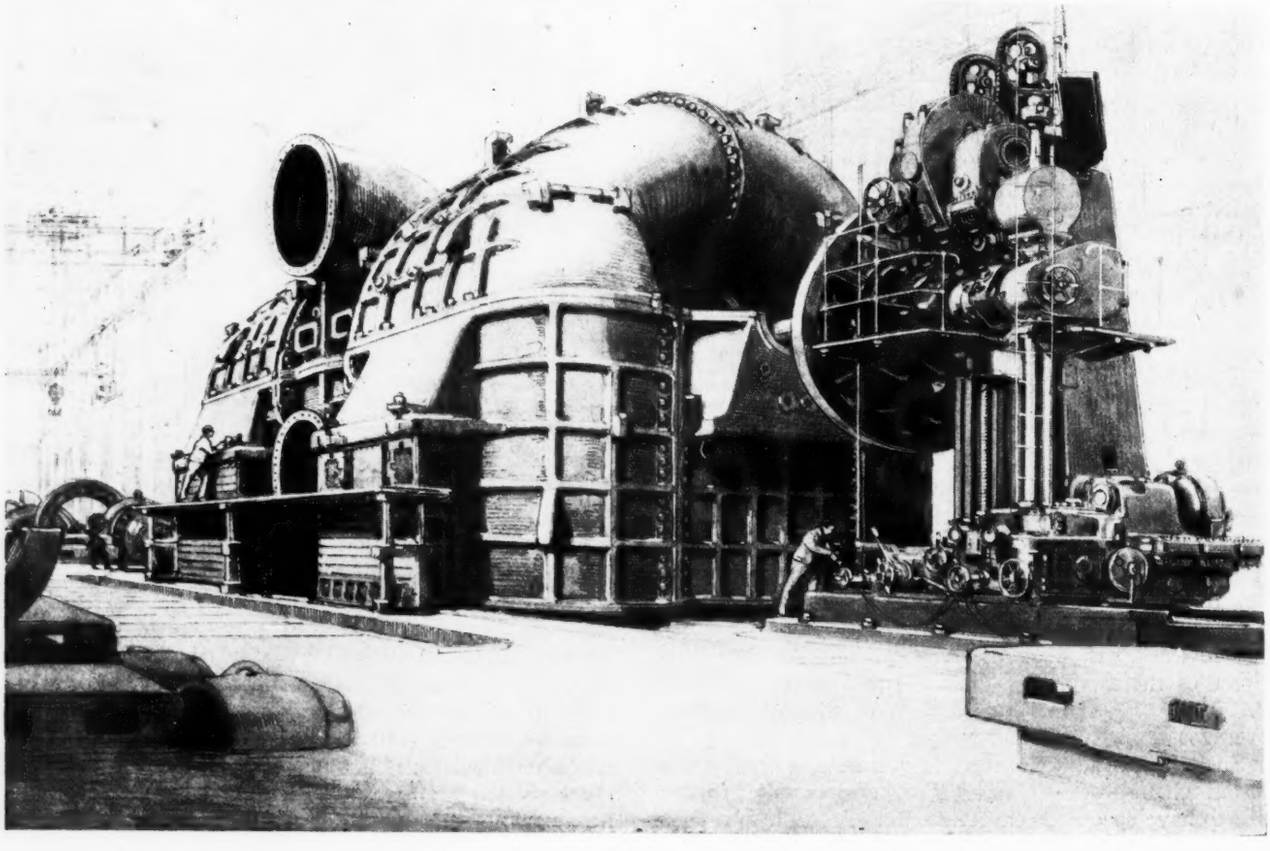
Boring High-Pressure Cylinder

160,000 Kw. Turbine

Installed at Hell Gate Station of United Electric Light & Power Co.

Sketches by Courtesy American Brown Boveri Corp.

Low-Pressure Cylinder on Boring Mill



Heat Balance Spots
CONTROLLABLE LOSSES*

By A. A. Potter and H. L. Solberg

Dean of Engineering, Purdue University

Ass't Prof. of Mech. Engineering, Purdue University

THE losses that occur during combustion and the absorption of heat by a steam boiler can be classified as follows:

1. Sensible heat carried away by the hot, dry flue gas.
2. Undeveloped heat caused by incomplete combustion:
   (*a*) Due to unburned CO in the flue gas.
   (*b*) Due to the unburned carbon discharged with the ash and refuse.
3. Loss of heat due to moisture:
   (*a*) Heat required to evaporate and superheat moisture in the coal to the temperature of the flue gas.
   (*b*) Heat required to superheat the water vapor in the air supplied for combustion to the temperature of the flue gas.
   (*c*) Unavailable heat lost in the discharge of the water vapor formed from combustion of hydrogen, at temperature of the flue gas.
4. Unclassified losses due to radiation, unconsumed hydrogen and hydrocarbons, and "unaccounted for" losses.

The remainder of the heating value of the fuel is absorbed by the boiler. Control of these losses will be discussed and means of ascertaining them graphically will be shown in connection with the following example:

Example 1. The following data were secured during a boiler test:

Analysis of Coal, per Cent by Weight		Analysis of Flue Gases, per Cent by Volume	
C =	78.76	CO_2 =	12.7
H =	5.07	CO =	0.4
O =	6.33	O_2 =	6.1
S =	0.78	N_2 =	80.8
N =	1.44		
Ash =	6.18	Total =	100.0
Moisture =	1.44	Carbon in refuse = 20 per cent	
Total =	100.00		

Temperature of the air supplied, 70 deg. F.
Relative humidity of the air supplied, 70 per cent.
Temperature of coal, 80 deg. F.
Temperature of gases leaving boiler, 520 deg. F.
Heating value of coal, 14,130 B.t.u. per lb.
Barometric pressure, 29.20 in. of mercury.

Loss of Sensible Heat in the Dry Flue Gases

Slightly over 7.5 lb. of air is required per 10,000 B.t.u. for the perfect combustion of coal. The air actually supplied is generally from 20 to 200 per cent in excess of this. With ordinary coal from 12 to 30 lb. of dry flue gases leave the boiler at 400 to 700 deg. F. for every pound of coal burned. If the air is supplied at normal room temperatures, from 10 to 30 per cent of the heating value of the fuel is expended in raising its temperature to that at which the flue gases are discharged. This is the largest and most important combustion loss. It is directly under the control of the fireman and must be continually watched as holes in the fire and uneven fuel-bed conditions may permit large quantities of excess air to pass through. This loss may be solved graphically by means of Fig. 1.

There are three factors which influence this loss:

1. The temperature of the air supplied for combustion.
2. The temperature of the flue gases leaving the boiler.
3. The weight of flue gases per pound of fuel.

The first, the temperature of the air, is not under control of the operator. It can be controlled in the original design of the plant. The temperature at which the flue gases are discharged depends upon the steam pressure, cleanliness of the surfaces, the design of the boiler and its setting, the rate of driving, the percentage of excess air and the amount of heat-saving equipment in use. The final temperature can be reduced by the use of economizers or air preheaters. In the boiler not equipped with an economizer the loss due to the flue gases becomes more serious as the steam pressure is increased. The operator can keep the temperature of the flue gases to a minimum by making sure that all baffles are tight so

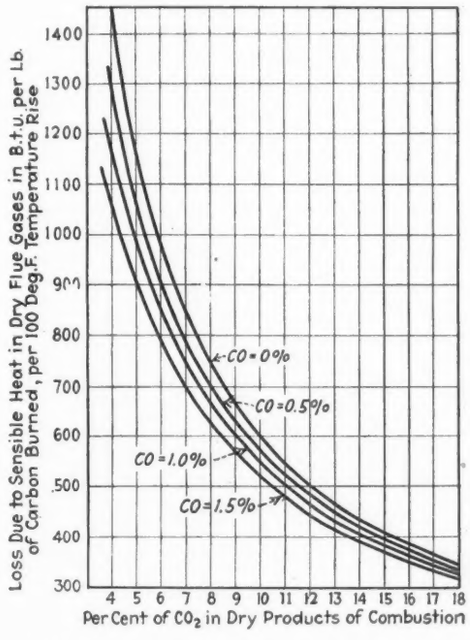


Fig. 1—Loss due to sensible heat in the dry products of combustion, in B.t.u. per lb. of carbon burned, per 100 deg. F. increase

*All rights reserved by the authors.

that the hot gases do not short-circuit, and by keeping the boiler tubes clean inside and outside.

The weight of the flue gases per pound of coal is under the direct control of the operator and has the greatest bearing on the loss of heat. An increase in the air supplied results in a double loss, for it not only increases the weight of gases to be heated to the discharge temperature, but it also increases the temperature of the flue gases. Fig. 2 shows the effect of excess air upon the temperature of the flue gases leaving a Type W

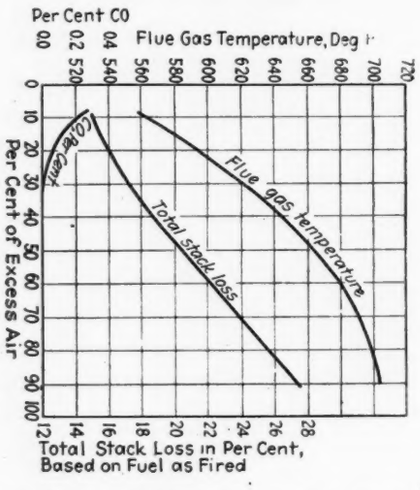

Per Cent CO
Flue Gas Temperature, Deg F
Per Cent of Excess Air
Total Stack Loss in Per Cent, Based on Fuel as Fired
Flue gas temperature
Total stack loss
CO, Per Cent

Fig. 2—Effect of excess air on flue-gas temperature, CO and stack losses. Boiler operated at a constant load of 155 per cent rating

Stirling boiler at the Conners Creek power house of the Detroit Edison Company.[1] An increase in the excess air of from 10 to 100 per cent increased the temperature of the stack gases about 140 deg. F.

Loss Due to Unburned CO

Because of insufficient air, stratification and poor mixing in the furnace, or too small a combustion space, some combustible CO may be present in the flue gases. Reference to Fig. 3 shows that only 1 per cent of CO may mean a loss of over 5 per cent of the heat of the fuel. Where the CO content is over 1.5 per cent, free hydrogen may be present also. The presence of hydrogen is not determined by the ordinary methods of flue-gas analysis, and a very small quantity would result in serious loss because of its high heating value. Fortunately, hydrogen burns 2.86 times as fast as CO, and it is seldom found in the flue gases unless the CO content is excessively high.

Loss due to the escape of CO increases with the reduction of excess air, since it becomes increasingly difficult for each molecule of CO to find the oxygen necessary for its combustion. On the other hand, a reduction in the amount of excess air results in a reduction in the sensible heat carried away by the flue gases. Consequently, a small amount of CO will usually be found in the flue gases when the boiler is operated under conditions of maximum efficiency.

Analysis of the flue gases for CO_2 only should be discouraged. While high CO_2 is ordinarily taken as an indication of low stack losses and efficient operation, it may be accompanied by excessive quantities of CO which are not detected unless a complete analysis is made of the flue gases.

[1]Article by A. K. Bak, *Power*, Vol. 59, page 634.

The extent of this loss depends upon the ash content, the burning characteristics of the coal, the kind and size of stoker, the combustion rate and the percentage of excess air. The three important combustion losses that are under the control of the operator are:

1. Loss due to sensible heat in the dry flue gases.
2. Loss due to the presence of CO in the flue gases.
3. Loss due to carbon discharged into the ashpit.

These are intimately related in that a reduction in the amount of excess air will reduce the first one and increase both of the others. Fig. 4 shows the relationship between excess air and these heat losses. These curves show only the general trend, as their exact shape depends upon the fuel-burning equipment and the boiler. However, with any given installation some point will be found at which the sum of these three losses will be a minimum. The point of maximum efficiency is not the point at which the loss due to sensible heat in the dry flue gases is a minimum, but the point at which the sum of all three of these losses is a minimum.

Moisture in the Fuel

A certain amount of heat is lost in evaporating and superheating the moisture in the coal to the final temperature at which the flue gases are discharged. With the better grades of coal this is not serious. In the case of lignite and waste fuels, where the moisture content may be from 30 to 60 per cent, it represents a considerable loss. Some coals burn better when wetted

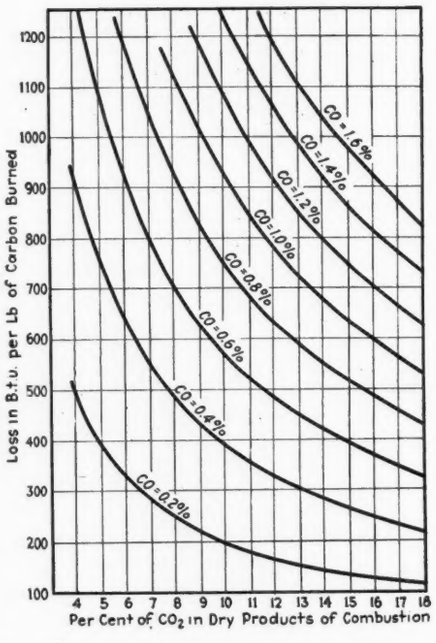


Fig. 3—Loss in B.t.u. per lb. of carbon burned, due to incomplete combustion of carbon to CO

before being fed into the furnace. The wetted coal does not sift through the grate as readily as dry coal, and the fuel bed is more open and porous. This loss may be found graphically from Fig. 5.

Loss Due to Water Vapor from the Combustion of Hydrogen

The combustion of one pound of hydrogen produces nine pounds of water vapor. In the determination of the heating value of the fuel by means of the calorimeter, the water vapor so formed is condensed and cooled to the

original temperature of the fuel, thereby giving up to the calorimeter its latent heat. In the actual combustion of the fuel the water vapor is discharged as superheated steam at the temperature of the flue gases. Consequently, the heating value as determined by the calorimeter includes the latent heat of the water formed from the combustion of the hydrogen, whereas this heat is not available and is lost when the products of combustion are discharged at ordinary flue-gas temperatures.

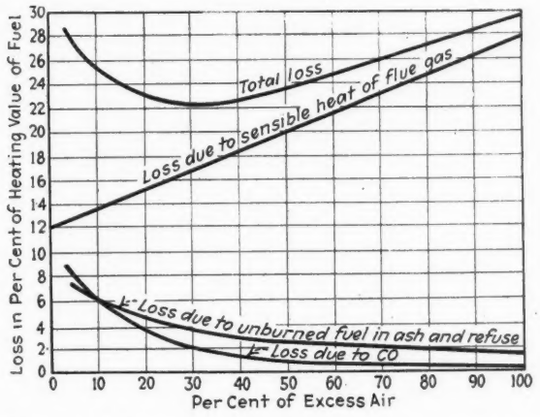

Loss in Per Cent of Heating Value of Fuel
Per Cent of Excess Air
Total loss
Loss due to sensible heat of flue gas
Loss due to unburned fuel in ash and refuse
Loss due to CO

Fig. 4—Effect of excess air upon the losses due to CO, carbon in ash and refuse, and sensible heat in the flue gases

The loss in B.t.u. per pound of fuel, due to the water vapor formed from the combustion of hydrogen can be calculated from the equation,

$$h = 9H(1{,}089 + 0.46\,t_2 - t_1)$$

where H is the hydrogen content of the fuel in per cent by weight.

The use of the lower, or net, heating value has been suggested as being more desirable than the higher heating value, which is determined by the calorimeter. The lower heating value does not include the latent heat of vaporization of the water vapor formed from the combustion of hydrogen, so that this loss of heat, which is unavoidable, would not appear in combustion calculations, but would be deducted directly from the reported heating value of the fuel. However, there is no generally accepted method of calculating the lower heating value, and the higher one is commonly used in this country.

Superheating of Moisture in Air Supplied for Combustion

Air always contains a small amount of water vapor which exists in the form of superheated steam unless the air is saturated, in which case it exists as saturated steam. The heat required to superheat this vapor to the discharge temperature of the flue gases is generally less than 70 B.t.u. per pound of coal and is often ignored in combustion calculations.

Loss Due to Unconsumed Hydrogen, Hydrocarbons, Soot, Smoke, Radiation and Unaccounted for

Under this heading are grouped the minor losses which are small individually and which cannot be easily determined. The loss due to moisture in the air is often included under this heading also. These "unaccounted for" losses are determined by subtracting from the heating value of the fuel the sum of all the calculated losses plus the heat absorbed by the boiler. Consequently, all errors made during a test appear in this item. With a good boiler setting the numerical value of this loss is generally between 2 and 5 per cent of the heating value of the fuel.

The loss due to the escape of unconsumed hydrogen and hydrocarbons is negligible if the CO is maintained within reasonable limits. If the CO is over 1.5 per cent, this item may be of some importance. The loss due directly to soot and smoke is seldom over 1 per cent, even in extreme cases. The radiation loss from a good boiler setting is ordinarily between 1 and 3 per cent of the heating value of the fuel and depends, among other things, upon the rating at which the boiler is operated. It may be quite high if the boiler is operating on a light load.

If the radiation and unaccounted for loss in Example 1 is assumed to be 4 per cent of the heating value of the coal, the various losses may be summarized in the following heat balance (see Table I).

TABLE I—BOILER HEAT BALANCE (Based on Example 1)

	B.t.u. per Lb.	Per Cent
Loss due to sensible heat in dry flue gases	1,606	11.4
Loss due to unburned CO in flue gases	240	1.7
Loss due to combustible in ash and refuse	225	1.6
Loss due to moisture in coal	18	0.1
Loss due to water from combustion of hydrogen	570	4.1
Loss due to moisture in air	33	0.2
Radiation and unaccounted for (assumed)	565	4.0
Total heat loss	3,257	23.1
Heat absorbed by boiler, by difference	10,873	76.9
Heating value of coal	14,130	100.00

The common method of testing a boiler and stoker is to measure the coal and water input and determine the heating value of the coal. It is then possible to calculate the boiler efficiency. Unless special equipment is installed in the plant for measuring the water, it is often difficult to secure accurate data from which to determine the efficiency. The tests must be long, generally at least 24 hours, in order to minimize the error due to having a different amount of coal on the grate at the end than at the start. Even in the most carefully conducted tests the error may be as great as 2 per cent. Where the purpose of the test is to improve the efficiency—and this is the purpose of practically all tests with the exception of

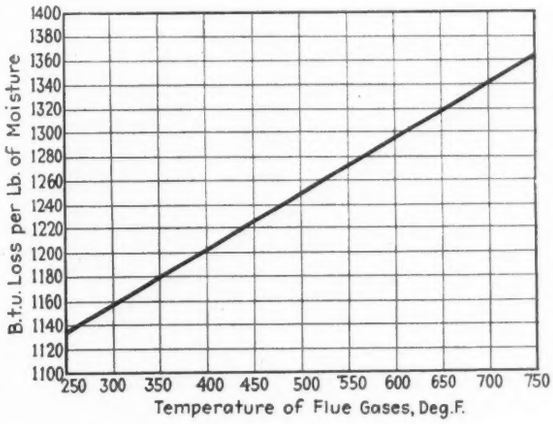


Fig. 5—Loss in B.t.u. per lb. due to moisture in the fuel

Based on the formula, B.t.u. loss = w (1,089 + 0.46 t_2 — t_1) where w = weight of free moisture in 1 lb. coal;
t_1 = initial temp. of coal;
t_2 = discharge temperature of flue gases.
Initial temperature of coal = 70 deg. F. If the temperature of the coal is above 70 deg. F., subtract (t_1 — 70). If the temperature of the coal is below 70 deg. F., add (70 — t_1).

acceptance tests—the heat balance is the important result, and this can be calculated from the analysis of the coal, ash and refuse, and flue gases. The boiler efficiency can be determined with a fair degree of accuracy by merely assuming the loss due to "radiation and unaccounted for," calculating the other losses and assuming that the remainder of the heat is absorbed by the boiler.

TABLE II—TYPICAL BOILER HEAT BALANCES

(No Economizers)

Results expressed in per cent of heating value of fuel.

	Poor	Average Small Plant	Fair	Excellent
Heat absorbed by boiler....	50.0	60.0	70.0	80.0
Loss due to sensible heat in dry flue gas	28.6	22.1	15.9	10.3
Loss due to CO in dry flue gas	3.5	2.5	2.0	0.5
Loss due to combustible in ash and refuse	6.0	5.0	3.0	1.3
Loss due to moisture in coal	1.0	0.8	0.7	0.7
Loss due to moisture formed from combustion of hydrogen	4.5	4.3	4.2	4.0
Loss due to moisture in air.	0.4	0.3	0.2	0.2
Loss due to radiation and unaccounted for	6.0	5.0	4.0	3.0
	100.0	100.0	100.0	100.0

Maintenance of Circuit Breaker Operating Mechanism

By E. K. READ

Circuit Breaker Engineer,
Westinghouse Electric & Manufacturing Company

IT SOMETIMES becomes necessary to replace the closing coil on the solenoid operating mechanisms of oil circuit breakers. This is easily accomplished on the

Fig. 1—Removing the core and brass tube, as a unit, from the closing solenoid

mechanisms used on circuit breakers made by the Westinghouse Electric & Manufacturing Company if the following procedure is adhered to, which is shown in the figures.

The operating rod connecting the main lever of the mechanism to the circuit breaker should be disconnected, then the closing core and the accelerating mechanism are disconnected in the order named. The main lever can now be removed. The bolts holding the stationary core to the magnet frame can be removed and the stationary and moving cores removed as a unit. Do not pull up on the moving core, but with a bar pry the stationary core up from below, high enough so the brass tube surrounding the moving core can be grasped. The fiber washers holding the coil against endwise movement

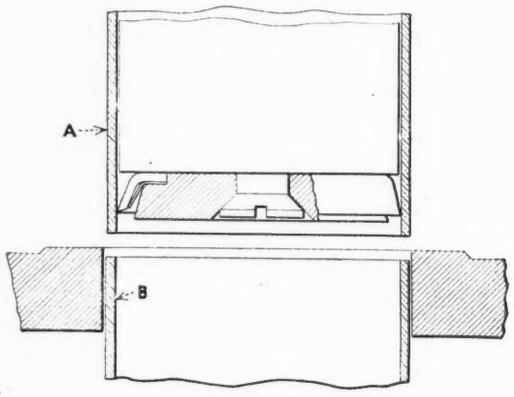


Fig. 2—Method of placing the movable core into its tube

should be pushed out and the coil then is free to be removed.

The parts should be replaced in the reverse order. When the fiber washers are replaced they should be put back at the lower end of the coil. Putting them in on top will reduce the pulling power of the solenoid and increase the minimum voltage at which the mechanism will operate the breaker.

In case the moving core is removed from the brass tube fastened to the stationary core, the leather in the end of the moving core flares out, making it difficult to replace the core. The best method of replacement is to take another tube of the same inside diameter as the stationary-core tube and slide it down over the leather, compressing it to the same size as the tube into which it is to fit. This is shown clearly in Fig. 2, *A* being the tube used to compress the leather and *B* the tube in the mechanism. When the two tubes are placed directly in line, the transfer from one to the other is easily made. If many of these mechanisms are installed, a hand tool for the maintenance men is three tubes about four inches long and with inside diameters of three, four and six inches, with walls one-sixteenth to one-eighth inch thick.

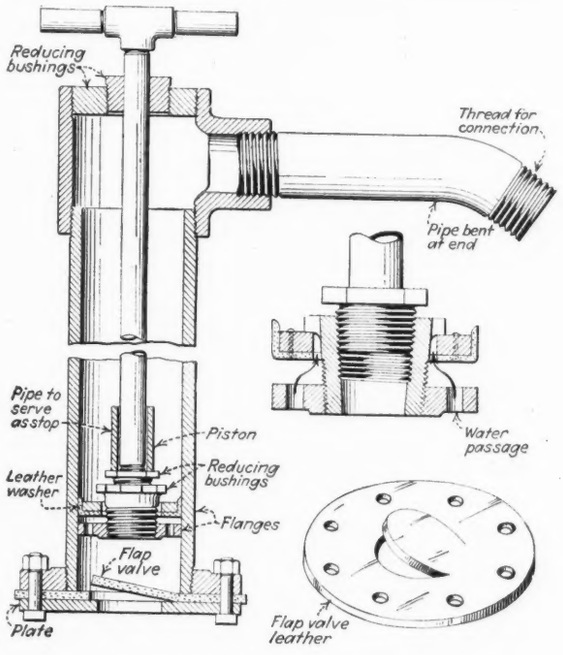
If tubes are not available, the leather can be compressed by using a fine wire or strong cord, making two wraps just back of the flared end. Drawing up on the ends of the wire or cord will reduce the leather in diameter until it can be inserted into the tube. Replacement is made by working the leather into the tube with the fingers. Using a screwdriver or similar instrument should be attempted only as a last resort; unless very carefully done, an air channel may be left in the leather. This channel will allow air to leak from the dashpot and affect the operation of the switch. The leather should also be kept in good condition by the application of a small amount of neat's-foot oil. Leather that has become too dry will allow the switch to close too violently. Proper care of oil circuit breakers, like any other equipment, pays good dividends and insures reliable operation.

Right Out of the Plant

BOILED-DOWN EXPERIENCE PASSED ALONG TO THOSE WHO MUST SAVE MONEY, IMPROVE THE PRODUCT AND KEEP THE PLANT RUNNING

Bailing Pump Made from Pipe and Fittings in Emergency

AROUND power or manufacturing plants there is occasional need for a bailing pump. A practical and readily made hand pump, put together hurriedly in



Assembly and detail of hand pump

one plant, to clear a flooded boiler room, is shown in detail in the attached sketch. This pump is made almost entirely of pipe, with the minimum of machine work and fitting. The foot valve contains a simple arrangement of leather flap valve. The piston is fitted with a leather facing and weighted closing valve.

The details will be clear from the drawing, and, as will be evident, the size can vary to provide a pump from most any stocked pipe parts around the plant.

Washington, D. C. G. A. LUERS.

Unequal Air Gaps Cause Parallel-Operation Trouble

TWO similar 150-kw. two-phase alternators were unsatisfactory when running in parallel. A current circulated between the two machines which did not reach the external circuit. The windings and connections of both machines were checked and found correct. The phase voltages were the same. Adjusting the exciting current did not apparently improve the operation.

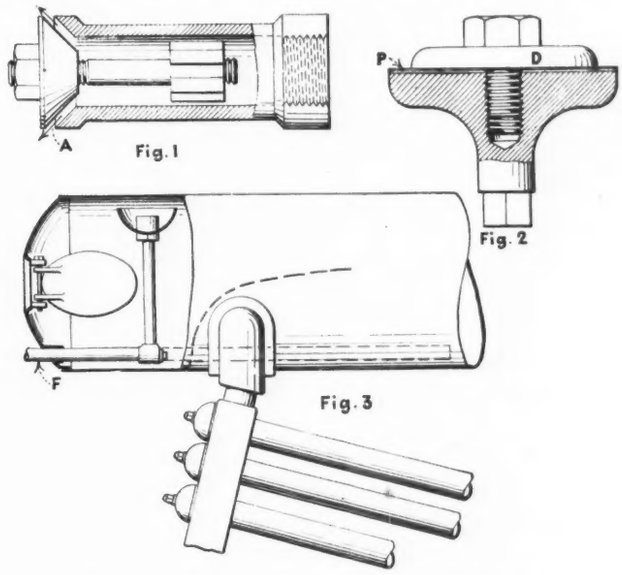
It was thought that the voltage waves of the two machines might be different. To test this a lamp was connected in one phase of each alternator. The machines were then rotated just fast enough to cause the lamps to light. The lamp on one machine burned fairly steadily, while on the other the light of the lamp continually fluctuated in synchronism with the revolutions of the machine. This indicated a lack of uniformity of the magnetic flux in the machine. On examination, the length of air gap at the top of the rotor was found to be double that at the bottom.

When the bearings were adjusted so as to equalize the air gaps, the two machines ran in parallel satisfactorily, showing that the unequal air gap was the cause of the trouble. Where alternators have to be run in parallel, the magnetic flux around the rotor of each machine must be uniform. To secure this, the field coils must be free from faults so as to be of equal strength, and the air gaps must be the same, as the width of the air gap determines the resistance offered to the magnetic field.

Brentford, England. W. E. WARNER.

Tool to Facilitate Boiler Cleaning

THE illustration shows some tools we have made to facilitate the washing of our boiler and the cleaning of the ground joints on the headers and caps. The cleaning tool, Fig. 2, is made to fit the hand brace and to carry



Tools used for washing tubes and cleaning header and cap joints

two or three sheets of paper as shown. The clamping disk *D* enters the cap holes in the headers and serves as a guide. The tool is light and easy to handle. For cleaning the faces of the caps and nuts, we have a machined cast-iron block upon which sheets of sandpaper are clamped.

Fig. 1 shows how we altered a spray head to make it suitable for washing tubes. The end of the head and deflector plate were each given an angle of 45 deg., and

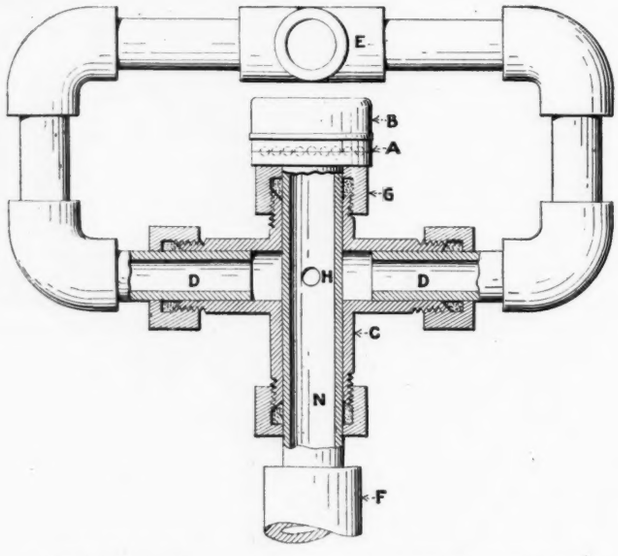
the opening was spaced so as to produce a conical discharge of water at high velocities. This spray head, with a pressure of 125 lb. on it, makes a good job of washing the tubes.

In the boiler drums the manheads are hinged as shown. We insist on this because of its convenience and also because it permits us to use the same gasket over and over again. Originally, the boilers were fed through a horizontal pipe extending along the bottom of the drum to a point five feet from the front head. These pipes gave trouble by filling with scale, so they were finally removed and the water was fed into the steam space as shown. A plugged tee with a riser in the side outlet was installed, the tee being placed so that the swinging manhead would clear the riser. On the upper end of the pipe we fitted a spherical tray as shown, it being clamped in place between a locknut and a tee screwed on the side outlet. After a run the pan and riser were generally found to be heavily coated with mud and scale. We are well pleased with this method of feeding the boilers.

Elgin, Ill. W. L. PARKER.

Improving the Operation of the Hand Lance

IN BLOWING the tubes of our boilers with a hand lance, we found that swinging the lance sidewise twisted the hose slightly and that the first three or four feet took most of the grief, and the hose usually failed in a short time. After trying several kinds of hose with unsatisfactory results, we made the swinging joint illustrated to obviate twisting the hose with the motion of the lance.



Swinging joint used to overcome twisting of hose

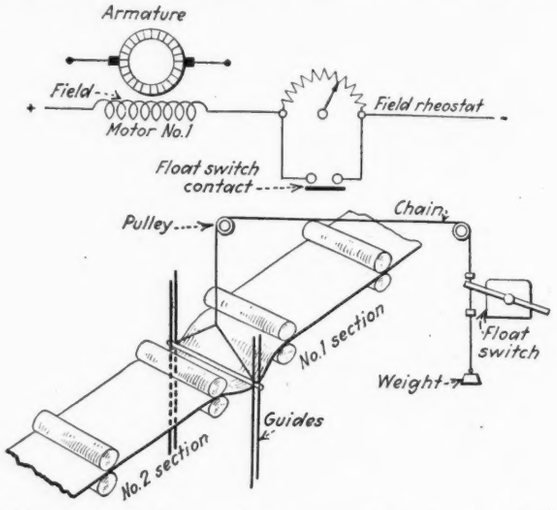
We had bronze castings made at a local foundry and the machine work was done in our own shop. The illustration shows the special cross with a stuffing box and gland on each opening. The hose *F* is connected to the lower end of the brass nipple *N* that passes through the cross *C* as shown. There is a cap *B* on the upper end of the nipple and a washer and ball bearing beneath it, which rest on the top of the gland *G*. The part of nipple *N* in the center of the cross *C* has holes *H* drilled through it to allow steam to pass into the lance. The lance and operator's handle are screwed into the standard cross *E*.

The blower end of the lance had received attention earlier. The lance was laid on the boiler-room floor and steam was turned on. The effect of the steam upon the material on the floor was noted. A plain cross was then screwed to the pipe and the three openings were closed with plugs, each having a $\frac{1}{8}$-in. hole drilled through it. These holes were later enlarged and tapered until the best type of nozzle was found. The holes were tried after each change until satisfactory results were obtained. They were finally made $\frac{5}{32}$ in. in diameter at the inside end and $\frac{3}{16}$ in. at the outside end and were about $\frac{1}{2}$ in. deep. P. L. WILSON.

Chicago, Ill.

Float Switch Regulates Motor's Speed

AT THE plant of the Dunlop Tire & Rubber Company one of the tread calenders had a section added after the original installation, which required a separate driving motor. Since the speed of this one section had to be changed every time the calender speed changed, it was decided that there was need for an automatic speed-regulating device to make supervision unnecessary.



Diagrams of float-switch connections for regulating the speed of a tread calender in a rubber plant

After the drive had been looked over, it appeared that speed changes were comparatively few and that a sensitive device was unnecessary. A float switch and a field rheostat, as shown in the figure, were tried as an experiment.

A light rod with vertical guides at each end was allowed to ride over the continuous tread of the rubber sheet, passing between the two sections. If the tread became too slack, indicating that the motor speed was high, the field rheostat would be short-circuited out by the closing of the float switch. If the tread tightened up too much the float switch would open and the rheostat would again be inserted in series with the motor field, causing the speed to increase.

This arrangement is, of course, conducive to hunting if many speed changes occur. However, the use of an adjustable rheostat allows the operator to set the amount of regulating resistance. The operation of this equipment has been satisfactory.

Buffalo, N. Y. B. COGSWELL, *Engineer*,
Buffalo General Electric Company.

As the Other Fellow Sees It

WHERE THE MAN WHO AGREES OR DISAGREES WITH AUTHORS OR EDITORS HAS A CHANCE TO SPEAK UP

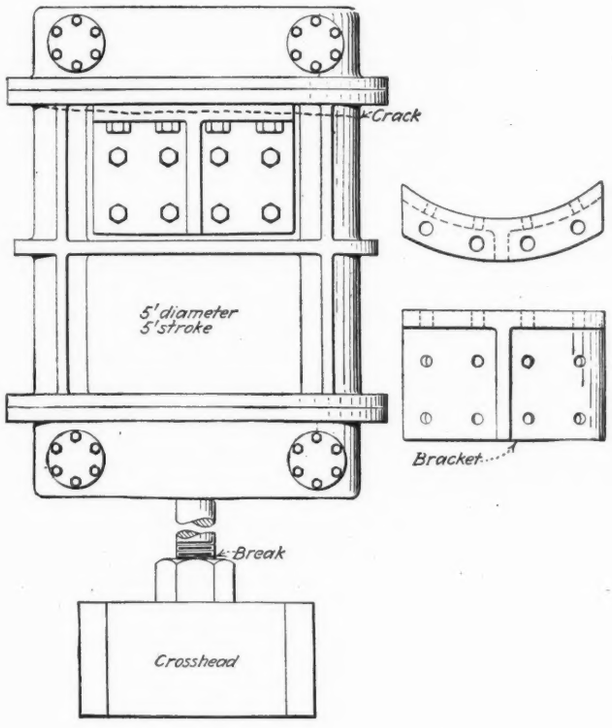
Unusual Failure of Large Pumping Engine

AN UNUSUAL smashup of a large pumping engine recently occurred in a near-by pumping station.

The unit was a 22,000,000-gal., triple-expansion, vertical Corliss engine of the water-works type. It was built about 1905 and has run practically continuously since.

The cause of the smashup was the piston rod breaking at the crosshead and allowing the piston to drive out the top head of the intermediate cylinder.

The engine had a 5-ft. stroke, and the intermediate cylinder was 5 ft. in diameter. The valves were in the



How the repair was made

head, and when the rod let go it drove the top flange of the head up and cracked the head both at the flange and across the valve ports.

The unusual feature of the break was at the piston rod which was 7 in. in diameter. From looking at the rod it appeared that someone had sawed it nearly in two and left about one square inch to hold it together. How long the crack was in the rod is hard to guess, but owing to the great stress in this type of engine it is hard to believe that it had been there very long, even though the crack appeared old.

To repair it we are casting brackets as shown in the detail to fasten on the side of the cylinder, and we intend to pull the crack together after filling it with a cement.

Rosedale, L. I. JOSEPH O'BRIEN.

Cost of Burning Coal

A RECENT article in *Power* suggests that the cost of preparation is often not given due consideration by those adopting pulverized coal. It costs money to burn coal in whatever manner it may be fired, and more attention should indeed be given this subject—not only preparation cost but total burning cost.

This cost, including the fixed charges and maintenance of the coal preparation and burning equipment, power, labor and other items, should best be expressed in terms of cents per ton of coal burned. Such cost, equalized with the net average combustion efficiency, is necessary to obtain the real over-all efficiency of the boiler plant.

A small hand-fired boiler operated at moderate rating, will have a small fixed charge and negligible upkeep cost as far as the equipment is concerned, but generally a high labor cost expressed in cents per ton. Generally, the cost of burning the coal in the smaller hand-fired plant is high and the efficiency low, so that a poor net over-all efficiency may be expected.

With mechanical stokers higher fixed charges and maintenance are encountered, but generally there is a great reduction in labor. The fixed charge will vary considerably, depending upon the two factors of first cost and the amount of fuel burned per year.

An expensive stoker and setting are often provided where the load factor is 10 per cent or less, indicating operation at nominal boiler rating for a few hours a day. In such a case the fixed charges may be a big item in the burning cost. A $6,000 stoker burning 600 tons of coal a year at a fixed charge of 15 per cent would mean a cost of $1.50 a ton. Allowing for amortization and obsolescence, the fixed charge perhaps should be figured even higher.

Maintenance cost in cents per ton will vary as greatly as the fixed charge, with the type of equipment, character of the coal and the rate of burning. The average cost of stoker maintenance is around eight cents a ton.

Power requirements will vary from a negligible amount with many natural-draft stokers, to an appreciable figure with stokers using forced draft, as the power to supply the air must be included.

Labor will vary with the completeness of the coal-handling equipment and the amount of coal burned, the labor cost per ton being small in the larger plants.

Taking all these items into consideration, it can be seen that the cost of burning coal should be given as much thought as the combustion efficiency, for often it is an appreciable percentage of the cost of the coal.

What has been said of the mechanical stoker also will apply to pulverized-coal equipment. The storage system of burning pulverized coal involving driers, pulverized-coal bins and transport system, results in a high fixed charge where the amount of coal handled is relatively small. It may not be high where the tonnage is large. The introduction of the unit pulverizer, however, has cut the investment to a point where it is comparable with that for the better class of stokers.

There are pulverizers that will handle coal regardless of its moisture content, where heated air is available from air-cooled walls, furnace gas or air preheater, so predrying the coal need not be considered. Some of these pulverizers will feed and pulverize coal containing a considerable percentage of oversize, foreign matter, tramp metal and rock, obviating any preparation plant, screens or magnetic separator where mine-run screenings are available. For these reasons the maintenance cost may range as low as two to five cents a ton. The power consumption is generally higher than that required for stokers, including, of course, in each case the power required for the air supply.

Coming to the actual choice of the equipment, combustion efficiency should be computed as the sustained yearly average efficiency to be expected under all specific conditions of the individual plant, not test nor guaranteed efficiencies. An ordinary hand-fired grate has a possible efficiency of at least 78 per cent in a good setting and can be made to meet such a guarantee by an expert fireman. The average efficiency of hand-fired grates is perhaps nearer 50 per cent.

It is not what a mechanical appliance can do or might do, but what it actually will average under a given set of conditions that really counts. It is perhaps here that pulverized coal has its greatest appeal, because, independent of any fuel bed condition or variation, an efficiency nearer the theoretical can be sustained without much effort on the part of the operator.

Next comes the consideration of the various items entering into the cost of burning the coal, namely, the fixed charges covering the cost of the equipment, the maintenance cost, power and labor—figuring the cost in cents per ton based on the amount of coal burned. It is apparent that a given burning equipment that can maintain efficiently a higher rating with a given boiler capacity than some other equipment, will be worth more money, owing to the saving in boiler and plant investment. The item of greater first cost, higher maintenance or higher power consumption often may be offset by greater over-all capacity and greater dependability. Peak-load capacity, the possibility of using low-grade emergency fuel and freedom from smoke are factors that must not be overlooked.

Buying combustion apparatus must go farther than a mere comparison of price and manufacturers' guarantees as to what the apparatus will do under test conditions. It must go farther than mere comparison of the various items of operating costs, one against the other.

Minneapolis, Minn. H. G. LYKSEN.

* * * *

For Better Purchasing of Equipment

IN THE description of the 100,000-kw. unit installed by the Brooklyn Edison Company, in the Nov. 15 issue, are some features dealing with the purchasing of equipment that seems well suited for more ordinary use among engineers and purchasers of various machinery and appurtenances. I am referring to those items where the customer gave to the builders the layout of the space into which the apparatus would be placed, their specifications of quality and what operating conditions would be, then let the builders design to meet the required conditions.

We must realize, of course, that the unit referred to is an exceptionally large one, requiring a great amount of engineering study and forethought for the operation of it, but there is no doubt that the designing engineers solved the various problems with the greatest advantage possible to the purchaser at prices consistent with the quality specified and the results expected.

Proportionally all purchasing should be given equal study and a thorough understanding be had with the manufacturers of whatever conditions the equipment under consideration has to meet. It is not practical to have made-to-order equipment for every necessity, but often better application of stock material can be made to existing conditions. Operating engineers too often act on their own judgment and experience for the purchase of new material and deny themselves the privilege of using the experience and study of the manufacturer's engineers. The latter are generally specialists in their respective lines and are usually ready to give their service even though the sale is small. Behind most equipment is a field of study in its use under various conditions, and the manufacturer's service means to the engineer the benefit of this study.

Keyport, N. J. GEORGE B. LONGSTREET.

* * * *

Variable Factors in Boiler Tests

TOO much importance should not be attached to results obtained from short-run boiler tests, for there are many factors, other than the mechanical operation of the test, that may radically affect the results.

This was well illustrated in a recent test of a 6,000-sq.ft. water-tube boiler. The test runs were for a duration of seven hours and were so conducted that the boiler might steam under operating rather than purely test conditions. Instructions were left with the boiler-room crew on the afternoon previous to the day of the test, indicating the rating desired, the time the boiler should be steaming at that rating and the time that the ashes should be dumped.

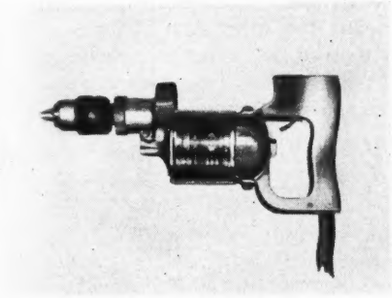
As for the test routine, thorough preparations were made; the water weighing tanks were examined and the scales calibrated, the coal weighing scales were completely overhauled and calibrated and the boiler meter was set to read accurately the steam and air flow. After runs had been made at loads ranging from 75 per cent to 175 per cent of the boiler rating, an analysis of the results was made. The last two runs at 165 per cent and 175 per cent clearly brought out the importance of the variable factors in short-run boiler tests. On the first run, at 165 per cent rating, 29,000 lb. of water per hour was evaporated with 3,900 lb. of coal per hour; on the second run, at 175 per cent rating, 30,857 lb. of water per hour was evaporated with only 3,786 lb. of coal per hour. The same grade of coal was used on both runs. A study of the boiler-meter steam and air chart for the hours directly preceding the tests revealed the cause of this discrepancy.

In the first of the two runs the fire had been dumped just previous to the start of the test, and 1,000 lb. more coal had been used the first hour to deepen the fire bed than on the following day, when several hours had elapsed after dumping before the test was begun. The boiler-room crew, not realizing the importance of following their instructions to the last detail, may cause serious discrepancies to alter the results. It is best for the test engineer to see personally that his instructions are carried out in bringing the boiler to the test conditions. Long runs should be made where possible in order to neutralize the effect of variable factors.

Ardmore, Pa. WALTER W. SLOCUM,
Public Service Electric & Gas Company.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES



Portable electric drill

Light-Weight Portable Drill

A LIGHT-WEIGHT portable electric drill, designed to take drills $\frac{3}{8}$-in. and smaller and for grinding and buffing work, is shown in the illustration. The complete drill weighs approximately $7\frac{1}{2}$ lb. and is especially adapted to general repair work.

The drill is powered by a universal motor controlled by a trigger switch in the handle. A drill stand, so designed that the drill may be held vertically for drilling or horizontally for grinding, can be furnished. The tool is put out by the Wodack Electric Tool Corporation, 4627 West Huron St., Chicago, Ill.

Improvements in the Ljungstrom Air Preheater

AMONG the recent improvements made to the Ljungstrom air preheater manufactured by the Air Preheater Corporation, 25 Broadway, New York City, is the use of a new form of heating element designed to increase the heat transfer and efficiency, with a consequent reduction in the over-all size of a unit for a given capacity. The essential change from the design of heating element previously used is the substitution of undulating partition sheet *B* (Fig. 2,) for the former flat-type sheet. The undulations are in transverse direction to the vertical channels formed by the corrugations of the companion sheet *A*.

This new arrangement gives greater heat transfer through increased turbulence and wider penetration of flow, compelling the gas and air to strike against, instead of merely passing over, the metal surface. Owing to the increased heat transfer, the heating elements are made shorter in length and have passages much larger in cross-sectional area. The use of these larger channels tends to reduce materially the gas loss through both gas and air sides and afford greater protection against fouling from soot. It is also pointed out that fly ash and entrained carbon are more positively carried out of the preheater, and the soot blower is more effective in dislodging any accumulation.

In addition to the adoption of the new heating element other design changes make the arrangement more compact with either integral or independent fans and further reduce the space occupied by an installation for a given capacity. The rotor drive also has been simplified, and in some sizes of the integral-fan type a fully cooled outboard fan bearing has been substituted for the central internal bearing previously used.

Both the integral fan-type preheater (Fig. 1) and the one formerly offered for independent fans (Fig. 3) have shallower inlet and discharge chambers for both gas and air, giving a shorter over-all height for given capacity. The connections below the rotor of the integral fan type and all connections in the independent fan type may be located in the end or side of the housing. An additional independent fan type, with all-vertical inlet and outlet connections, is now available. This type makes the ducts serve as inlet and outlet chambers and reduces the over-all height to less than half that of the former design.

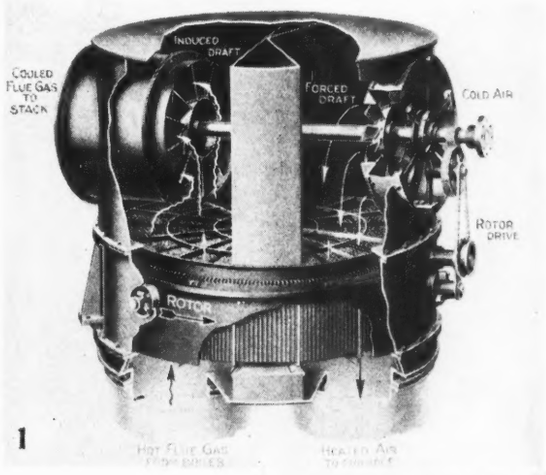


Fig. 1 — Improved integral fan-type preheater

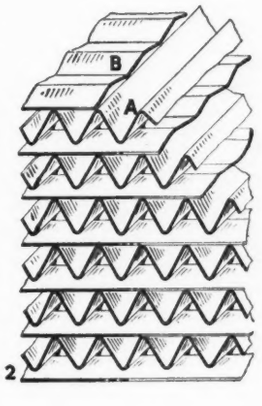


Fig. 2 — Improved heating element

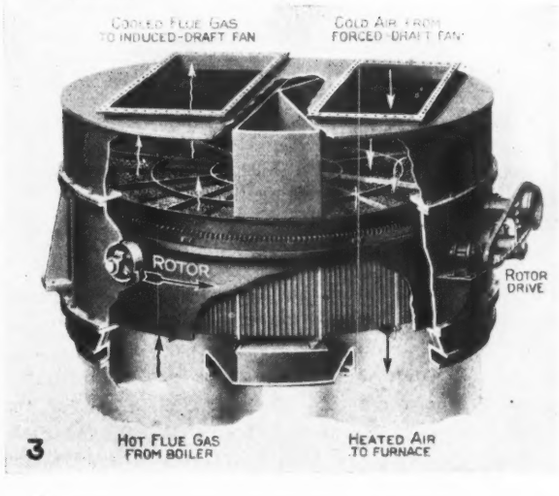


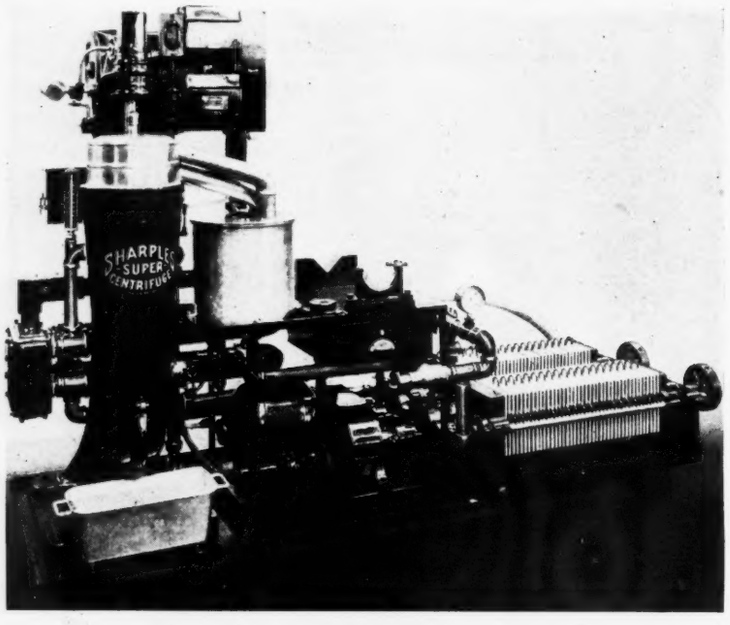
Fig. 3—Independent fan-type preheater with all vertical inlet and outlet connections

Combined Portable Centrifuge and Filter Press

A RECENT addition to the oil filtering and purifying equipment put out by the Sharples Specialty Company, Philadelphia, Pa., is the combined portable centrifuge and filter press illustrated.

The capacity of the new machine is rated at 900 gal. per hour. The filter presses, of which there are two, have twenty plates apiece of each type, and five filter papers are placed between adjacent plates, making a total requirement for each press of 200 papers. With new oil the total capacity of 900 gal. per hour can be fed through both presses at a pressure of 15 lb. and through a single press at a pressure of 25 pounds.

The unit is assembled complete with motor, pumps, piping and valves. The piping is so arranged that the oil can be run through the centrifuge only and discharged directly to storage without passing through the presses. Valves are also arranged so that either press may be cut off at will, and a check valve prevents pressure from the other press backing up into the one that is shut down. The machine is equipped with four 6-kw. heaters each, each two of which are

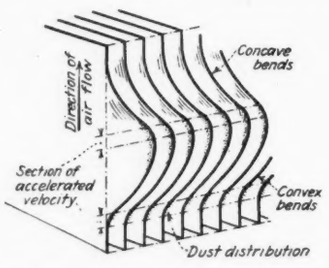


Centrifuge and filter press assembly

controlled by a quick-break knife switch mounted on the motor bracket. The motors driving the separator and pumps are controlled by push-button type starters. A sheet-metal cover is provided to protect the filter presses and a portion of the pump from dirt when the presses are not in service.

Sinuous Horizontal and Vertical Air Filters

A NEW air filter in horizontal and vertical types designated as models S-H and S-V respectively, in which the filtering medium is a series



Filtering medium is an assembly of curved plates

of viscous coated curved plates, has been brought out recently by the Midwest Air Filters, Inc., Bradford, Pa.

In the horizontal type illustrated herewith, curved plates or baffles are assembled in horizontal sections as shown. A number of these sections are grouped in a frame and baffled to cause the air to pass upward through the sections, as indicated. The principle upon which the filter operates is illustrated in Fig. 1. The plates are made with convex and concave bends, and it is pointed out by the manufacturer that the air flow, in passing through the cells, is simultaneously bent and accelerated, and centrifugal force is brought to bear upon the heavier dust particles, causing them to impinge and be held on the surface of the plates as indicated.

Cleaning of the filter is accomplished by means of a motor-driven pump which feeds viscosine through a header into pipes located directly over and extending the full width of the cells. The pipes travel back and forth across the cells during washing, only one row of cells being washed at a time. The same operation that cleans the filter also charges it with viscosine, for after the washing there remains upon the plates a fresh viscous coating, which acts as a trap for

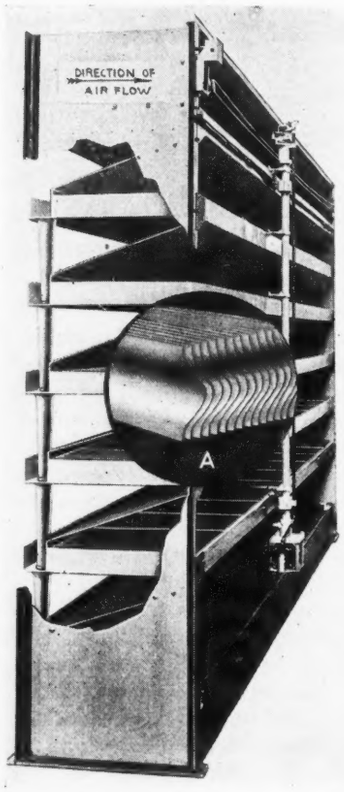


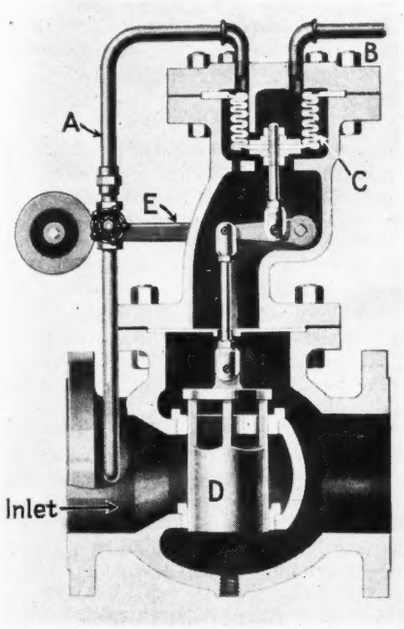
Fig. 2—Assembly of filter cells showing arrangement of washing pipes and enlarged view of filtering medium

the dust in the incoming air. The dirty oil flows down the baffle plate to a collecting trough at the bottom of each tier and thence to a settling tank in the bottom of the frame. Here the sludge is allowed to remain for a time depending on the dust concentration of the air. The tank is open and easily accessible from the clean air side of the filter. Its capacity can be figured at approximately 20 gallons per filter cell in width.

In the vertical type the filtering medium is essentially the same, except that the filter cell plates are grouped in series vertically instead of horizontally. The filter cells are all made three feet wide and the cells can be grouped to give capacities from 3,000 to 240,000 cu.ft. per minute.

Differential Water-Pressure Regulating Valve

A DIFFERENTIAL water-pressure regulating valve, designated as the Copes type SS valve and designed to regulate the excess water pressure across the control valve of a feed-water regulator, is a recent



Cross-section of regulating valve

product of the Northern Equipment Company, Erie, Pa. It is pointed out by the manufacturer that the valve is suitable for use in connection with any feed-water regulator and is designed to maintain the desired pressure drop, regardless of variations in boiler-drum pressure or pump pressure, or friction loss in the feed line to the individual boiler.

The pressure-regulating valve *D* is actuated by a four-ply brass sylphon bellows *C* which is subjected to, and influenced by, the differential water pressure. The inlet side of the control valve is connected with the outside of the bellows through the pipe *A*, and the discharge side of the valve is connected with the inside of the bellows through the line *B*. Any change in the water pressure in the feed line causes a movement in the bellows, which in turn adjusts the amount of the valve opening, thus maintaining the pressure drop for which the valve has been set. The desired pressure drop across the valve is adjusted by moving the weight on the lever *E*. The regulating valve can be cut out of service at any time by closing the valve in the line *B* and opening the valve in the line *A*.

The type SS valve is furnished in all sizes with straight-way style body only, in the 250-, 400-, 600-, 900- and 1,350-lb. standard. It can be placed in either horizontal or vertical feed lines.

Bituminous Lining for Steel Pipe

AMERICAN rights to a process for applying a bituminous type lining to steel pipe have been acquired by the National Tube Company, Pittsburgh, Pa., which is now marketing the pipe in this country. The process, which was developed in England, provides a practical means of preventing corrosion and minimizing loss of capacity due to internal incrustation or tuberculation. The lining consists of a molten bitumen, especially treated to give proper physical properties, mixed with a chemically inert filter ground fine. This is applied to the inside of the pipe by the centrifugal process, and gives a smooth surface having a glossy-mirror-like finish.

Pipe lined with this material can be furnished with any of the customary forms of exterior protection and is available in sizes from 4-in. upward. The lining has a minimum thickness of one-quarter inch on all sizes. Lengths available and type of couplings used are in accordance with conventional practice.

Elevator Controllers for Direct-Current Service

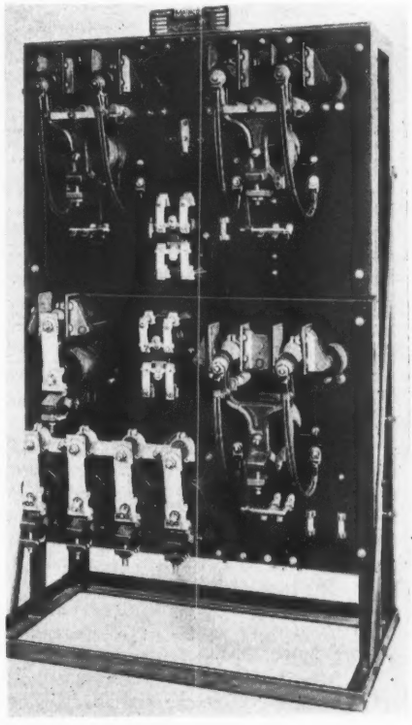
ELEVATOR equipment in many of the older types of buildings has proved to be inadequate when called upon to meet modern-day requirements. A detail in which most of the equipments give trouble is in the controller. By changing the control and the brake equipment, the operation of the old machine can be greatly improved. To take care of such conditions the Maintenance Company, Inc., 449 West 42nd St., New York City, has placed on the market a line of direct-current elevator controllers. These include non-reversing motor starters with single-pole magnet main-line switch; full-magnetic single-speed types; full-magnetic two-speed types; and full-magnetic types with potential switch and slow-down. The last-named type is shown in the figure.

The contacts on these controllers are of the wiping self-cleaning copper-to-carbon type and will not weld together when subjected to heavy currents. The heavy currents are interrupted by the main switches only, and these are provided with powerful blowouts to smother any tendency to arc when the circuit is broken.

Acceleration is obtained by counter-electromotive-force principle, consequently the rate at which the motor starts varies with the load. When the load is light acceleration is rapid, and when heavy it is slow. Dynamic braking is provided in the control to assist the electromechanical brake in stopping the machine.

On all full-magnetic controllers there is a combination interference and shunt-field sustaining relay. The interference contacts provide an electrical interlock for the direction switches to prevent a too sudden reversal of the motor by the operator.

A sequence or current-interruption relay is provided on all mechanically



Full-magnetic controller with potential switch and slow-down

operated controllers. This relay prevents the machine starting on return of power, after a temporary interruption in the current supply, if the operator leaves the controller in the running position. Special combinations of switches and relays can be provided to meet unusual requirements and conditions.

THE ENGINEER
And His Function

An address delivered by H. Boyd Brydon, Mechanical Engineer, Byllesby Engineering and Management Corporation, before the Eighth Annual Convention, Great Lakes Division, N.E.L.A.

I AM greatly honored by being asked to address you on the subject of the engineer and his function. I doubt very much if I can say anything new, but, at any rate, I can avoid the comment made by the great Macaulay on a book sent him for review, that there were things in the book both new and true, and the things that were true were not new and the things that were new were not true.

This matter of experience which differentiates the engineer from the cub is something more than years of service. Unless he applies to his experience the test of common sense his experience is of no use to him.

What is an engineer? The dictionary gives one of those illuminating definitions to the effect that he is a man skilled in engineering. In these days of specialization, engineering has many branches, and the things in which engineers following these branches must be skilled are, on the surface, widely different. However, there is, I think, one common ground upon which all engineers—civil, military, hydraulic, mining, electric, mechanical, or what not—may meet, one job they all have to do, and that is to provide "the best equipment for the service intended," to use a common specification phrase.

Now to do this an engineer must be an artist, for of course engineering is not a science, it is an art.

All art, whether it be the art of a a Phidias, a Michael Angelo, a Beethoven, or of any of the various kinds of engineers, consists in the usage of scientific truth to produce artistic truth. For the engineer, artistic truth generally consists in formulating the best compromise between contradictory requirements.

As an illustration of this, the design of a battleship has been used probably many times, but it is apt for my purpose. Among other desiderata a battleship should have the heaviest armor, the most powerful guns, the greatest steaming radius, the highest speed, the steadiest gun platform, the highest freeboard, the lowest exposure, the least personnel, and have throughout equipment that, in the stress of battle, shall not easily be deranged; and it should obtain these results with the least expenditure of money. Each one of these propositions involves a sacrifice of the others.

Surely, a nice judgment is required to correlate and order these conflicting factors into a practical battleship.

While our problems are not so difficult as this, nor the results so disastrous if we err, the difference is of degree, not of kind.

Our error may not result in our country's defeat, but it may involve much difficult work by the gentlemen of the purse strings.

They have to explain to the bankers why they need more money. They have to explain to the shareholders why dividends are not forthcoming.

Some time ago, the president of a large electric lighting company was introducing to a friend some of the executives and department heads in his organization and showing him around their new offices. When they reached the drafting room, the man who was escorting the pair through the offices said, "This is the drafting room. Here is where the work is done," whereupon the president of the company said, "Like h—— it is. The work is up in front getting the money."

What is it that differentiates a freshly hatched engineer newly clothed in academic honors from a man like—say like Alexander Dow, for example—whose delightful talks on his experiences and the judgments he has formed from them have warmed our hearts and renewed our enthusiasm for our work? Very probably the fresh young thing from the science school can sail rings around any of us old-timers in the way of mathematics, and yet nobody would take his word for anything on an engineering matter except the correctness of a mathematical expression, and would probably—nay, certainly—want that checked. Even after this the engineer would look at the figures in the light of his experience and would decide in the light of his experience how much to allow his decisions to be influenced by the truth of this mathematical expression.

And note that this matter of experience which differentiates the engineer from the cub is something more than years of service. Unless he applies to his experience the test of common sense, his experience is of no use to him. From the proper assimilation of experience, he must develop a sense of judgment. Not only must he be an artist, but he must be skilled in his artistry.

My professor of mechanical engineering, John Perry, in a lecture on machine design put it this way: He said, "After you have used all the knowledge you have obtained here and have designed your machine to the best of your ability, pin the drawing upon the wall and stand off and look at it. Turn it upside down if you like, and look at it. After a while, if you have any brains, you will begin to feel that it would be better to make this part a little heavier and that part a little lighter, and finally you may produce a design that may work. But only experience and the judgment that comes from experience can give you the ability to produce a design that will work."

There are many angles to this matter of providing the best equipment for the service intended. To some it is merely to produce the best result mechanically or electrically or thermodynamically, as the case may be. There seems to exist in their minds a sort of feeling that to discuss cost is sordid, unethical. Their attitude to the whole idea is impersonal—something like the Lord High Executioner's attitude in Gilbert and Sullivan's immortal operetta:

> *"Your majesty says kill a gentleman and a gentleman is told off to be killed."*

Being an engineer is not trying to erect a monument to oneself by beating some other man's B.t.u. record. As engineers we are not interested in building monuments. Our sole function is to produce the greatest result for the least money.

In the last few years I am glad to say, we have had less of this attitude. We have heard a good deal less about B.t.u. economy and a good deal more about

dollar economy. But the idea of dollar economy is the development of a comparatively few years. Probably it has been back in the minds of all of us in our work, but until very recently, and in fact even today, power houses are compared largely on the basis of the B.t.u. economy that they show.

Just recently no less august a body than the Prime Movers Committee of this association published a serial report entitled "Higher Steam Pressures and Temperatures."

It begins thus:

> "Economy data from ten representative high pressure and temperature power plants have shown a realization of theoretical gains from higher steam pressures and temperatures. Heat consumption rates of these stations supported by detailed data reconciling actual and calculated results are the ultimate proof of value from extended steam conditions."

Mark that, gentlemen. Heat consumption rates are the ultimate proof of value. Very little about load factor, nothing about the cost of fuel, nothing about investment costs. And when you turn to a table marked "actual station economy," you find that the station with the highest pressure is not nearly the most economical as measured by the yardstick of this report. Is it significant that the price of this report is forty cents?

Here I think we can discern one of the functions of the engineer—that he shall so order his thought and his work that he shall recognize that being an engineer is not trying to erect a monument to oneself by beating some other man's B.t.u. record. As engineers, we are not interested in building monuments. We are not particularly interested in heat consumption rates even. Our function, our sole function, is to produce the greatest result for the least

Has not the desire to have the highest steam pressure or the largest turbine or the most magnificent power house or the longest transmission line influenced to a great extent decision upon what should be a purely economic problem?

money—not for a month, not for a year nor for two or three years, but for duration, as General Kitchener's "Old Contemptibles" signed up. Duration may be fifteen years—it may be twenty years. And to do that job to the best of our present ability with all too little knowledge, in the hope that a few years hence it shall not contain too many errors.

So that, in addition to requiring experience and judgment, the engineer must be an economist.

His solution of the problem must be correct not simply as a thermodynamic solution. It must be correct as an economic solution.

In the search for the economic solution it is interesting to note the values that have been placed on some of the factors. Take, for instance, load factors of power stations. The development of the art, rapid as it has been, has not changed appreciably the shape of the demand curve for electricity. It is true that availability of raw materials and low transportation costs have settled in certain parts of the country industries that require large quantities of electricity, and that from the very nature of these industries the use of power is continuously at a high load factor. These, however, are particular cases, and it is still true that in the majority of our power stations the demand is roughly twice as large at some period of the year as it is at another.

Unfortunately, sometimes the glamour of high B.t.u. economy has set men worshipping the strange gods of high load factor in locations where high load factors are improbable or impossible because of the difficulty or impossibility of locating such industries in their neighborhood.

It is not necessary to consider these cases, nor such a large unit as a power station. It is only necessary to consider an individual machine. As the population of the country grows, the demand for electrical energy must also grow. This necessitates the installation of new units and the building of new power stations. As soon as a new unit is installed in a power station, it is given the cream of the load. As soon as a new power station is built, that station gets the cream of the load, and properly so; but this means that the older stations have a poorer load factor than they previously had. If this results in a given machine or a given power station having its load factor cut in half, the cost of electricity produced by that power house is increased, and that part of the cost which must take care of fixed charges is doubled. In other words, instead of having a year to earn your annual fixed charges on the old power station, you now only have six months.

Where are you going to get the money to pay the fixed charges on the old plant for the other six months? Out of the savings in operating cost of the new unit? If so, how much better off are you?

Take another instance. Lately, I have been investigating the ground space and cubic contents per installed kilowatt of the buildings used in certain recent plants.

In these days the cost of the building to hold the machinery is a very appreciable percentage of the cost of the machinery.

To my great surprise I found most varied figures. For instance, in one station containing two 60,000-kw. units, the area per kilowatt was 0.29 sq.ft. and the cubic feet per kilowatt 33. In another plant containing two 35,000-kw. units, the area was 0.34 sq.ft. and the cubic feet 31 per kilowatt. In another, containing two 30,000-kw. units, the area was 0.96 and the cubic feet 97 per kilowatt. In one plant containing two 10,000-kw. units, the area was 0.46 and the cubic feet 34. In another plant also containing two 10,000-kw. units, the area was 0.79 and the cubic feet 81. In another plant containing eight units ranging from 2,000-kw. to 25,000-kw. capacity, the area was 0.53 and the cubic feet 33.

The figures are for the boiler and turbine rooms only. They do not include switchboard space; switchboard requirements vary so greatly that the figures for this space are of very little value.

Nothing is gained by squeezing the last drop out of a price. In the first place it soon gets around that so-and-so likes to cut prices, and the result is the seller puts his price high enough to enable him to cut.

It is difficult to conceive conditions that necessitate such large and irregular variations in building space; from an area of 0.29 sq.ft. to an area of 0.96 sq.ft., and from 31 cu.ft. to 97.

Surely, there is something wrong somewhere in the estimate of this factor of the problem.

While judgment must be based on experience, some experimentation must of necessity be done in order that improvement may be made. Putting it differently, judgment must be fluid. I do not mean by this that every new thing that comes along should be adopted forthwith. Engineering work is not running an experiment station. It is using things that are true to obtain the best commercial result. The age of the things used is accidental.

Has the enormously rapid development we are witnessing proved of economic advantage to anyone, either maker or user? Or is it simply a reflection of the prevalent megalomania?

Has not the desire to have the highest steam pressure or the largest turbine or the most magnificent power house or the longest transmission line influenced to a great extent decision upon what should be a purely economic problem?

Certainly, the pathology of some very large equipment does not warrant confidence that the slight thermodynamic gain has been profitable.

It is reasonably common knowledge, however, that these continual changes in steam pressure, in ratings, in minor differences, frequently made simply at the whim of the purchaser's engineers, have not resulted in reducing the cost of equipment.

In these days of standardization, surely a profession whose very right to existence depends upon a logical mental process ought to be able to agree on certain standard sizes of equipment

and on certain standard operating conditions. At the least, the adoption of such standards would save time and reduce the cost of construction. It might even make possible a small percentage of profit for the manufacturer.

Certainly it would end lengthy conferences over trifles. For, after all, it makes very little difference how an engineer of mature judgment decides to do a piece of work.

"There are forty different ways
Of constructing tribal lays,
And every single one of them is right."

Besides, it will probably be wrong five years hence anyhow. The important thing is with the best knowledge he has available to use his best judgment and to decide.

This craze for records has a tendency to obscure another function of the engineer, and that is to hold a fair balance between buyer and seller.

Nothing is gained by squeezing the last drop of blood out of a price. In the first place, it soon gets around that so-and-so likes to cut prices and the result is the seller puts his price up high enough to enable him to cut; and, if he is clever, he doesn't have to cut all of it off again.

In the second place, he is in business to make money and when the price is cut the quality may be cut also. It is a poor rule that won't work both ways.

Again, it frequently happens in buying equipment that valuable improvements have been made to a piece of similar equipment bought only a year or two previously.

But the same man who would not expect to get a next season's car in flat exchange for one a year or two old seems to think it quite reasonable to expect a manufacturer, without charge, to bring up to date equipment that was the best available when the contract was let. To countenance such demands forms no part of the engineer's obligation to provide the best equipment for the service intended.

But the engineer's function holds yet a deeper significance. He is charged with the just expenditure of money put up by others. Not only must the engineer be an economist, not only must he deal fairly between the parties. His function is also that of a trust officer. The confidence reposed in him by his employers is that he will expend wisely and honestly the money they find.

A man may agree with himself to spend more money for a certain personal desire than good judgment would indicate. I remember very well a friend of mine who had a predilection for putting down his expenditures in a little book. This gentleman bought a new automobile and wanted to know what the new car cost to run. Accordingly, he carried a little book in the car, and all expenditures in connection with that car were put down in the little book. One day he started to add up these expenditures to see what his car was costing him, and found that the car was costing him more than he could afford. So he promptly threw away the book.

This may be done in one's individual expenditures, but it may not be done when one is expending other people's money. It makes little difference what the B.t.u. consumption of a power house may be. It makes all the difference, because it is a point of honor, the honor of the greatest profession in the world, that that money shall be spent in the best possible manner.

Pumped Water Used to Operate Hydro-Electric Plants

AN INCREASING number of American hydraulic engineers are becoming interested in the type of hydro-electric development in which water is pumped into a reservoir with off-peak energy in order to produce on-peak energy later. Few of them, however, know that this has been done for nearly half a century, that 42 plants have been built to date, that 21 of them have been built within the last five years and that their evolution has progressed to the point where 34,000-hp. pumps are being installed and a total pumping capacity of 250,000 kw. has been seriously proposed.

Ten more plants have been proposed in Europe, where practically all this development has taken place. In the United States, however, the first modern plant of this type has recently been completed by the Connecticut Light & Power Company on Rocky River, near New Milford, Conn., although 36 more have been proposed, among them being one to pump 5,000 sec.ft. against a 90-ft. head over a divide.

Those who are in close touch with the situation regard the Rocky River development as the first of a large number of such plants in this country. The inevitable human inertia due to a conservative attitude toward the transplanting of a European idea to American soil has now been overcome, and with the building of the first large plant in this country the development should be rapid.

Abstract of a paper, "Pumped Storage Hydro-Electric Plants," by William W. K. Freeman, published in the November, 1928, proceedings of the American Society of Civil Engineers. In this paper is a description of different types of hydro-electric plants that operate on pumped storage. A table is included that lists 42 plants of this type in Europe and the United States. One of these plants has pumps driven by 34,000-hp. motors. In an appendix the methods of operating the Rocky River Development of the Connecticut Light & Power Company is given. This abstract deals with the types of plants, methods of operation and economic aspects. Also the adaptation of existing hydro-electric plants to the pumped storage principle.

The principle on which these plants operate is that of building a storage reservoir where the natural conditions are favorable for the economic storage and utilization of water even if the natural inflow into the reservoir is negligible, provided there exists, a short distance away and at a lower level, a supply from which water can be pumped into the reservoir. This pumping is done with low-cost off-peak energy generated at steam plants or run-of-stream plants, in order later to obtain high-value peak energy from the storage reservoir. The process of using power to pump water into a reservoir and drawing it out again to obtain power would be uneconomical except for the fact that electric energy must be produced at the time the consumer requires it. The marginal cost of off-peak energy from steam turbine-generators which would be idle or partly loaded if it were not for the pumping load of a pumped-storage plant, is quite low; and the marginal cost of off-peak energy from water that would otherwise be wasted over the dams of run-of-stream plants (called "surplus hydro-electric energy") is practically zero. These conditions tend to make it economical to use this equipment, which would otherwise be wholly or partly idle, but on which nevertheless the fixed charges would be continuing, to pump water into a reservoir to produce power later when required, the arrangement resembling

an electric storage battery in its operation.

There are three types of plants, the storage development and two variations of it—the pondage and the part-head types. Rocky River is a plant of the storage type, in which two principles of operation are used. By the first, water is drawn from the reservoir to generate on-peak power in this plant only, and is replaced by an equal quantity within the same day or week, pumped into the reservoir with off-peak power. In this case there is no net depletion of the reservoir, and the plant is said to operate on the pondage (that is, short-time storage) principle.

The second is the flow-regulation principle in which water is drawn from the reservoir not only to produce power at this plant, but also to increase the low-water flow in the main river for the benefit of downstream plants. This operation differs from that common to all storage reservoirs only in the fact that the reservoir is filled by pumping because the natural inflow is too small.

Nearly four times as many pondage plants as storage plants have been built. In this type only short-time storage is economical and the feature of releasing water to regulate the flow of the river below the reservoir, as described for the storage type, is absent. Some have pumps of enormous size; as, for instance, the Hengstey plant now under construction in Germany, which has 34,000-hp. pumps. Among the developments of medium size are some reservoirs formed by dikes on hillsides, while a few of the reservoirs are so small that they are made of reinforced concrete.

A number of the plants of this type have two reservoirs, one forming the forebay of the plant and the other the tailrace. In this case the only additional water used, once the lower reservoir is filled, is that required to replace leakage and evaporation. This type of plant extends the possibilities of hydro-electric development to locations where it has never been considered, because practically no natural flow of water is necessary. It requires only suitable natural or artificial pools at different elevations, with the proper hydraulic works.

Part-Head Plants

The part-head type plant pumps water against a certain head to make it available through a higher head. A common form of part-head development is one in which water is pumped into the penstock from a lake or other source of supply, and from where it flows up into the main reservoir. The only American plant built prior to Rocky River on which data have been found, is one of this type. In addition to the Mill Creek No. 2 plant at Murray, Utah, pumping is utilized at the Thousand Springs, Lake Waha, and Bear Lake developments in Idaho, but these are not true pumped-storage plants, because at Thousand Springs the pumping is done continuously and there is no storage of water during off-peak periods; and at the other two the water is pumped out of a reservoir that is filled by natural inflow, instead of into a reservoir deficient in natural inflow.

The writer hesitates to try to formulate general statements as to what conditions make plants of the three different types economical because of the infinite variations there can be in topography, market, competing power, and surplus power for pumping, all of which influence vitally the economy of any project.

In general, however, it may be said that the conditions that make ordinary hydro-electric plants feasible make pumped-storage plants feasible; for example, low investment cost per kilowatt of firm capacity; high cost of competing fuels; large and concentrated system loads, etc. Although the pumped-storage plant labors under the disadvantages of the added cost of the pumping equipment and operation, it has certain compensating advantages over ordinary storage plants, some of which may be enumerated as follows:

1. It is comparatively independent of rainfall and drainage area, although, of course, a high average annual rainfall on a large drainage area means less pumping.

2. In the more settled areas land and other damages are likely to cost less for a given reservoir capacity because the plant is on a tributary instead of on the main river.

3. Since, for a given reservoir capacity, drainage area is smaller, the provision for floods is less expensive, if not absent.

4. The plant that pumps from a large river or from a pool is valuable as a reserve plant because water released in an emergency can be replaced by pumping.

5. Finally, among the most important advantages is the low cost of adding pumping and power equipment to an existing development to obtain more firm or reserve power. It is the writer's opinion that considerable activity will be shown in the United States in the adaptation of existing plants to the pumped-storage principle; the adaptation of one plant has already been seriously proposed.

A Method for Calculating Pounds of Air per Pound of Coal

By W. H. Martin
Oregon State College

For a number of years the writer has used the following method of computing the weight of air per pound of fuel and the weight of dry gas per pound of fuel from a flue-gas analysis. Its principal advantage over other methods is its simplicity and the ease with which it is understood. As will be noted, it is based on the fact that in a mixture of gases the weight of each is proportional to its molecular weight.

The Orsat determines directly the percentage of CO_2, O_2 and CO in the flue gas, and usually the remainder is assumed to be nitrogen. However, since it does not enter into the reaction, consideration of it in the calculations is merely excess baggage. A typical analysis of flue gas may be assumed as 13 per cent CO_2, 6 per cent O_2, and 0.2 per cent CO. If each of these percentages is multiplied by its molecular weight, a quantity will be obtained that is proportional to the weight of each individual constituent. Thus

$$\begin{aligned} 13 \times 44 &= 572 \\ 6 \times 32 &= 192 \\ 0.2 \times 28 &= 005.6 \\ \hline & 769.6 \end{aligned}$$

The sum of these values is proportional to the weight of these three gases in some larger quantity of gas.

In considering the molecular weight of CO_2, it is convenient to note that of the 44 parts of CO_2, 12 parts are carbon and 32 parts are oxygen. In like manner, of the 28 parts of CO, 12 are carbon and 16 oxygen. Two columns can be arranged and computed, the values in one being proportional to the weight of carbon and the values in the other to the weight of oxygen in the sample of gas.

Carbon	Oxygen
$13 \times 12 = 156$	$13 \times 32 = 416$
$0.2 \times 12 = 2.4$	$6 \times 32 = 192$
158.4	$0.2 \times 16 = 003.2$
	611.2

In a quantity of flue gas containing 611.2 lb. of oxygen there are 158.4 lb. of carbon. The pounds of oxygen per pound of carbon then will be

$$\frac{611.2}{158.4} = 3.86$$

To illustrate the method of computing the weight of air per pound of fuel, let us suppose a fuel containing 71 per cent carbon, 5.4 per cent hydrogen and 8 per cent oxygen is being burnt.

The oxygen used to burn the carbon in one pound of fuel will be.....$0.71 \times 3.86 = 2.74$	
The oxygen used to burn the hydrogen in one pound of fuel will be..$0.054 \times 8 = 0.43$	
Total oxygen used per pound of fuel.....	3.17
Oxygen supplied from the fuel	0.08
Oxygen supplied from the air	3.09

Since air is 23 per cent oxygen by weight, the amount of air supplied is

$$\frac{3.09}{.23} = 13.43 \text{ pounds.}$$

The weight of dry gas per pound of fuel is equal to the weight of air supplied plus the carbon and oxygen in the fuel, minus the oxygen used to burn hydrogen; $13.43 + .71 + .08 - .43 = 13.78$ pounds.

The heating value of coal decreases little by storage, possibly from an average of 1 per cent up to a maximum of 3 per cent during the first year in open storage. No deterioration is experienced with coal stored under water and little in a packed pile, while there is an apparent gain in heating value in coal stored under salt water.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING

INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

Midwest Power Conference Program Announced

Four-day Meeting Will Have Much of Interest to Power Engineers

SPONSORED by the same engineering organizations that have backed it in the past, the fourth Midwest Power Engineering Conference, to be held in Chicago from Feb. 12 to 15, inclusive, is now well mapped out.

A program arranged to touch upon the technical power problems of the various fields represented by the participating societies, gives promise of broad interest to all and specific interest to the members of each organization. There will be papers offered by leading authorities in the civil, electrical, mechanical, mining, metallurgical, heating and ventilating, and refrigerating fields, all prepared from the power angle, and therefore of prime interest to operating and technical engineers who have any connection with the power field.

The four-day meeting has been divided into six sessions, each having a direct power interest. Popular or semi-technical topics of current interest will be presented at noonday luncheons. Inspection trips, except through private arrangement, have been eliminated to give more time for technical discussion. Every minute in the day from Tuesday to Friday noon will be occupied, and the evenings, with one exception, will be devoted to attendance at the Chicago Power Show, simultaneously in progress. This mechanical exposition, as in past years, will be held at the Coliseum during the week of the power conference, and from present indications the show, as well as the conference, will be outstanding in its presentation of developments in the power field.

From a cursory glance at the tentative program, the first session of the conference will be devoted to power-plant substructure problems. A morning will be given over to the discussion of the metallurgy of materials used in power production, followed by an afternoon on electrical engineering subjects.

A full session will be given to heating, ventilating and refrigerating developments, and the two final periods of the meeting will feature power-plant operation and economics. An outstanding event will be the banquet and ball to be held Wednesday evening at the Palmer House, headquarters for the conference.

An outline of the program follows:

TUESDAY MORNING, FEB. 12

Registration at the Palmer House. Luncheon at noon; presidential address by W. L. Abbott.

TUESDAY AFTERNOON

Session on power plant substructure problems. "Details of Design and Construction of the Stream Flow Power Plant at Louisville, Ky.," by H. G. Roby, Byllesby Engineering and Management Corporation, Chicago; "Power Plant Substructure Problems," by J. C. Sanderson, Sargent & Lundy, Chicago. "Design and Construction of Substructure of Steam Power Stations in Various Localities in the United States," by P. E. Stevens, Byllesby Engineering and Management Corporation, Chicago.

WEDNESDAY MORNING, FEB. 13

Session on metallurgical and chemical problems. "Metallurgy of Material Used in Power Equipment," by Prof. A. E. White, University of Michigan; "Researches in Corrosion," by K. H. Logan, electrical engineer, Bureau of Standards, Washington; "Utilization of Power in Chemical Industries," by Dr. C. M. A. Stine, E. I. du Pont de Nemours & Co., Wilmington, Del. A luncheon meeting will be held under the auspices of the American Institute of Electrical Engineers.

WEDNESDAY AFTERNOON

Session on electrical engineering problems. "Synchronous Supervisory System and Telemetering," by C. E. Stewart, General Electric Company, Chicago; "Sight Seeing Among the Atoms and Molecules," by Prof. G. L. Clark, University of Illinois.

WEDNESDAY EVENING

Annual banquet, Grand Ball Room, Palmer House, at 7 p.m.

THURSDAY MORNING, FEB. 14

Session on problems in heating, ventilating, and refrigeration. "Modern Application of Refrigerating and Ventilating Principles to Everyday Use," by S. C. Bloom, consulting engineer, Chicago; "Application of Refrigeration to Preservation of Foods," by A. J. Authenrieth, Middle West Utilities Company, Chicago; "Research as Applied to Heating and Ventilating," by Samuel R. Lewis, consulting engineer, Chicago. Luncheon meeting will be held under the auspices of the Western Society of Engineers.

THURSDAY AFTERNOON

Session on power plant operation. "Centrifugal Pump Economics," by Prof. A. F. Scherzer, University of Michigan; "Co-ordination of Industrial Plant and Central Station Power," by R. J. Gaudy, Sessions Engineering Company, Chicago; "Welding in Power Plant Construction and Maintenance," by H. H. Moss, Linde Air Products Company, New York.

FRIDAY MORNING, FEB. 15

Session on power plant economics. "1,200 Pounds Pressure as a Dollar Saver," by Edwin Jowett, Kansas City Power & Light Company, Kansas City, Mo.; "Plant Practice and Engineering Insurance," by J. P. Morrison, Hartford Steam Boiler Inspection & Insurance Company, Chicago; "Modern Stoker Equipment," by C. F. Hirshfeld, chief of research, Detroit, Edison, Company, Detroit.

In the News

Preliminary efforts have been made by the A.S.M.E. and the S.P.E.E. to formulate a set of standards for drafting room practice. This effort should receive the heartiest support of all who are interested, for it is one more milestone on the road to simplification, which means economy, efficiency, and better mutual understanding. The first requisite of a language is that it shall be understandable to all who use it. Standardization alone can accomplish this result.

Industrial Fuel Conference Held At Yale

TWO hundred engineers, officials and metallurgists attended the industrial fuel discussion which was held Dec. 12 at New Haven, Conn., under the auspices of Yale University and the Connecticut Manufacturers Association. The entire day was given over to an open discussion of the merits and disadvantages of the use of oil and pulverized coal for industrial purposes. Presi-

dent James Rowland Angell welcomed the gathering, which included single representatives from many plants in the State.

E. Kent Hubbard, president of the Connecticut Manufacturers Association and a member of its research committee, was a principle speaker. He described the advantages of the dual agreement and its success since inception. This is the third meeting of a series of conferences on the various fuels.

Papers were then presented on various aspects of industrial fuel. In the morning session pulverized coal was considered, and after lunch, oil heating. A discussion period followed the presentation of each paper.

The meeting was made possible through a co-operative agreement between the university and the research committee of the State Manufacturers Association. Thus the laboratories and personnel of the college are at the disposal of members of the Manufacturers Association, and in return the Association extends the loan of industrial equipment, and assists in the training of specialists and employment of Yale graduates. It is the purpose of this broad agreement to bring about a closer and more co-operative understanding between education and industry.

A.A.A.S. Annual Meeting to Hear 2,000 Papers

Astronomy, evolution and the inadequacy of professorial pay will be among the subjects discussed at the annual meeting of the American Association for the Advancement of Science, opening on Dec. 27 in New York City, and scheduled to continue for seven days. The attendance will include more than 5,000 scientists, some of whom will be distinguished visitors from Great Britain. Dr. Arthur H. Compton, of the University of Chicago, Dr. Harlow Shapley, of Harvard University, Dr. Arthur A. Noyes, of the California Institute of Technology, and Dr. Michael I. Pupin, of Columbia University, will be among the prominent men present. Dr. Herbert H. Turner, of Oxford University, dean of British astronomers, will be one of the speakers.

Drafting Practice Recommendations Issued

A set of illustrated recommendations has just been issued by the sectional committee of the A.S.M.E. on the standardization of drawings and drafting-room practice. The recommendations are in tentative form and deal only with line work. They are being widely distributed among engineers for the purpose of criticism and approval by all who are interested.

The recommendations are in printed form and are contained in ten sheets in which are illustrated various types of drafting lines, the methods proposed for the representation of sections of all kinds, and conventional symbols for various materials. Comments are carried in columns running parallel with the figures.

The Sectional Committee on the Standardization of Drawings and Drafting Room Practice consists of 53 members representing 32 national organizations. It was organized in 1926, with the Society for the Promotion of Engineering Education and the A.S.M.E. as joint sponsors. The committee states that it is desirous of obtaining all possible constructive criticism on the proposed drafting-room standards, which, it points out, are entirely tentative in character. C. B. LePage, assistant secretary of the A.S.M.E., will receive these comments.

Spot * News

BUFFALO GENERAL ELECTRIC COMPANY *has just placed in service a 75,000-kw. turbine unit which is the world's largest single-cylinder machine. This is at the Charles R. Huntley station in Buffalo, and is built for 25-cycle operation.*

* * *

MEXICO *has adopted a boiler code, the inference being that, contrary to popular belief, stray bullets are not the only risk to which the citizens have been subjected.*

* * *

A RELIEF MAP *twenty-seven feet long and twenty-five feet wide has been installed in the basement of the United States Senate Office Building at Washington, showing with the most minute accuracy the topography of the Colorado River basin. It was built by the Department of Water and Power of the City of Los Angeles, and has been brought to the capital to assist in the debate on the Colorado River bill.*

* * *

THE COLORADO RIVER BILL, *having been passed by both houses of Congress, as this issue goes to press, awaits the action of the President. Mr. Coolidge's signature will not make the bill into law, however, since six of the seven interested states must first ratify it. Only five, so far, have signified their acceptance of the measure as it stands.*

* * *

THREE MORE LIGHTSHIPS *are to be built with Diesel-electric drive. The first three were ordered by the government nearly a year ago. Four 75-kw. engine-driven generators will be installed in each, to be used separately while the ships are at anchor and in combination when under way.*

* * *

THOMAS A. EDISON *was present in phantom at the Schenectady plant of the General Electric Company, Dec. 15, when a tablet was placed on the original building of the plant, occupied by the Edison Company 42 years ago. From his home at West Orange, N. J., the inventor addressed the audience over a special radio hook-up.*

* * *

THE FINAL UNIT *of the Queenston-Chippawa development on the Canadian side of Niagara Falls has been ordered from the Westinghouse Company. Like its nine predecessors, it will be rated at 65,000 hp. and will involve $5,000,000 worth of additional construction.*

* * *

SAWDUST AND CORNSTALKS, *recently suggested as the future source of fuel, are also figuring in the manufacture of synthetic lumber, according to a western lumbering firm, which is placing the utmost faith in the future of synthetic chemistry.*

A.S.H. & V.E. Making Final Preparations

AN AMBITIOUS program has been conceived by the Illinois Chapter for the 35th annual meeting of the American Society of Heating and Ventilating Engineers, which will be held at the Edgewater Beach Hotel, in Chicago, Jan. 28-31, 1929. Preparations are being made to accommodate 600 members and guests, according to the statement of H. G. Thomas, general chairman, who has announced the personnel of the committee that will act as host to the society at this meeting.

Prof. F. B. Rowley, chairman of the program committee, reports that many excellent papers are under preparation. Among those to be presented will be: "The Summer Comfort Zone," by C. P. Yaglou and Philip Drinker, of Harvard University; "Comparative Results on Hot Water and Steam Heating," by F. E. Giesecke; "Refrigerating as Applied to Air Conditioning," by S. C. Bloom; "Coefficients of Transmission for Air Spaces," by members of the University of Minnesota, and a report of the committee on rating heating boilers.

An elaborate program for the ladies has already been arranged, including luncheons, teas, the annual ball, and other special features. The technical sessions will be held in a large meeting hall in the Edgewater Beach Hotel, which has been fitted up with comfortable chairs for the purpose. Arrangements have also been made with the various railroads for the use of the certificate plan of reduced fares for members coming from outside points.

New James River Plant Planned

Award of a general contract to Reinhart & Dennis, of Charlottesville, Va., for the construction of a dam and power house for the Hydro-Electric Corporation of Virginia, located at Cushaw, on the James River, 23 miles west of Lynchburg, Va., was announced recently by W. C. Whitner & Co. Inc., consulting engineers for the project.

Plans call for a five-unit, 10,000-hp.

plant whose yearly output will be 25,000,000 kw.-hr. Equipment is to consist of James Lefel & Company vertical waterwheels, oil-pressure valve-wheel governors, manufactured by the Woodward Governor Company, and five Westinghouse waterwheel generators with direct-connected exciters. Control will be supervisory from the plant and the Balcony Falls station of the Virginia Public Service Company.

A concrete, gravity-type dam, 1,550 ft. long and 28 ft. high, will span James River five miles east of where it breaks through the Blue Ridge Mountains. It will have an impounding area of 137 acres. Power-driven trash rakes and welded racks are to be installed by the Newport News Shipbuilding & Drydock Company.

Power equipment is to be housed in a 55 x 165-ft. brick and concrete structure. September, 1929, is set for date of completion.

Huge Lignite Reserves Found in North Dakota

The part of North Dakota lying west of the Missouri River, says a recent bulletin from the U. S. Department of the Interior, is richly endowed with beds of lignite, which, though of low rank and of small present value compared with other coals of the country, constitute a tremendous reserve supply of fuel that sooner or later will be called upon to supply light, heat and power to the inhabitants of this and surrounding regions.

The report, recently issued by the Geological Survey as Bulletin 775, describes the Marmarth field in southwest North Dakota. This field is a part of the great lignite-bearing region of western North Dakota, northwestern South Dakota and eastern Montana. It includes an area of about 1,800 square miles, lying principally within the valley of the Little Missouri River. The coal occurs in beds that are commonly as much as 8 to 10 ft. thick, and one bed ranges from 20 to 30 ft. in thickness over a large area.

As a result of the Geological Survey's examination it was found that the field now contains a reserve of lignite estimated at more than 15,000,000,000 tons. The coal in this one field constitutes an amount comparable with the total quantity of coal mined in the United States since coal was discovered—18,000,000,000 tons.

With the Society Sections

American Engineering Council, annual meeting, to be held in Washington, D. C., Jan. 14-15, 1929, at the Mayflower Hotel.

A. S. M. E., Knoxville Regional Meeting. Mar. 21-23, 1929. Technical program and trips to points of interest.

American Water Works Association, New York Section. Meeting, Dec. 28, at the Hotel Pennsylvania. This will be a luncheon meeting.

United Engineering Society, dinner, in New York City, Jan. 7, 1929, for the purpose of receiving the report of the committee on war memorial to American engineers, on the Louvain carillon and clock.

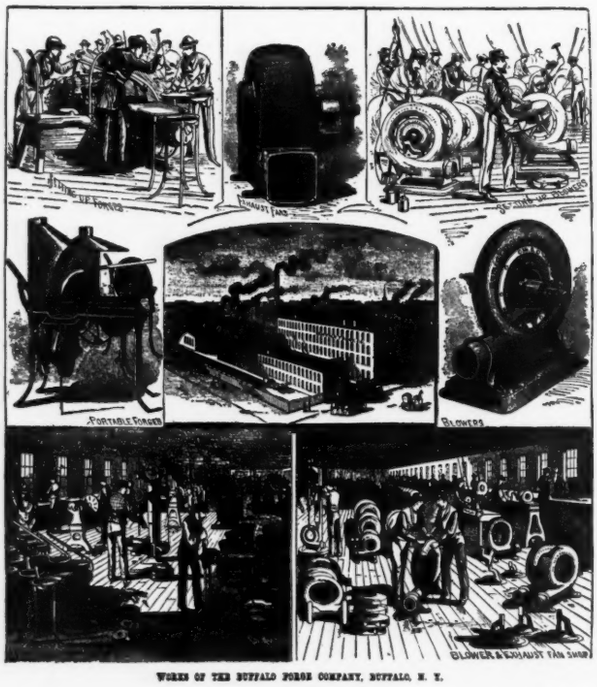
American Water Works Association, Kentucky-Tennessee Section. Annual meeting, to be held at Chattanooga, Tenn., Jan. 24-26, 1929.

National Marine Engineers Benefit Association. The 54th annual meeting will be held in Washington, D. C., Feb. 11-16, at the Hotel Hamilton.

Engineers' Club of St. Louis. Meeting Feb. 13, 1929. Subject: "Steam Storage and Steam Distribution," by R. A. Longworthy, vice-president and general manager of Ruths Accumulator Company.

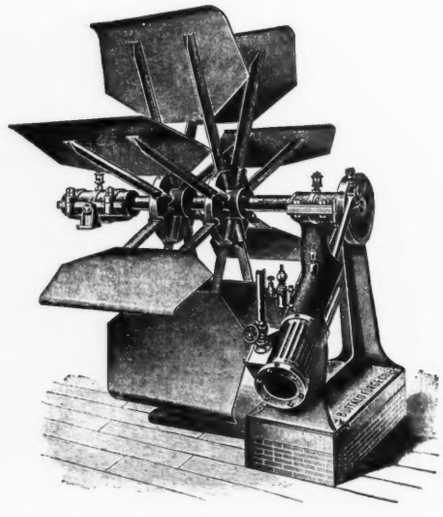
OBITUARY

JOHN E. YORKSTON, seventy, consulting engineer and veteran of the General Electric Company, died suddenly from heart attack on Dec. 10 in his office at the Schenectady plant of the company. Mr. Yorkston was born and educated in Glasgow, Scotland. He was graduated from the Glasgow School of Arts, Andersonian University, and the Glasgow Technical College. Com-



WORKS OF THE BUFFALO FORGE COMPANY, BUFFALO, N. Y.

A Golden Anniversary



THE BUFFALO FORGE COMPANY is this year celebrating its fiftieth anniversary in the manufacture of blowers and allied equipment. In 1878 Charles F. Brunke and Charles Hammelman began the manufacture of portable forges in Buffalo, N. Y. Three years later they entered the heating and ventilating field, and from that time forward grew and prospered. The cuts show some of the early manufacturing processes and products.

ing to Schenectady in 1881, he obtained a position as machinist in the General Electric plant. In 1894 he was advanced to designing draftsman, and in three months was given charge of the A.-C. drafting department. In 1902 he was made assistant engineer in charge of the drafting department, succeeding to engineer in charge in 1907. In 1922 he was made consulting mechanical engineer.

PERSONALS

GEORGE S. HUMPHREY, formerly chief engineer of the Potomac Edison Company, was recently elected a vice-president of the company and will have charge of Operations and Engineering, reporting directly to the president.

ROBERT B. BURNS, formerly associated with the Requa Electric Supply Company, Inc., has opened a manufacturers' agency office in Builders Exchange Building, Rochester, N. Y., representing such firms as the Allis-Chalmers Manufacturing Company, Allen Bradley Company and the Falk Corporation.

W. J. HENDERSON, formerly associated with H. T. Hopson, announces the opening of an office at 150 Broadway, New York City.

JOHN D. STILES, vice-president of Jenkins Brothers, has retired after forty years of continuous service. His retirement was made the occasion of a dinner on Dec. 12 tendered him by fellow members of the United States and Canadian branches of Jenkins Brothers.

BUSINESS NOTES

THE CONSOLIDATION COAL COMPANY, New York City, announces the appointment of W. W. Stevenson as assistant to the president, with offices at 15 Broad Street, New York City.

THE PLIBRICO JOINTLESS FIREBRICK COMPANY, Chicago, Ill., announces that its Trenton, N. J. plant is in process of enlargement, and will be twice its present size when completed, thus becoming the larger of the company's two plants.

THE COLT'S PATENT FIRE ARMS MANUFACTURING COMPANY, Hartford, Conn., announces the removal of its Chicago Office to a new location. The new quarters will be at 618 West Jackson Boulevard.

THE SQUARE D COMPANY, Detroit, Mich., announces a reorganization and transfer of capital stock, resulting in the appointment of T. J. Kauffman as president. Mr. Kauffman assumes these duties in addition to those of general manager and operating head of the business, a position which he has held for the last seventeen years. Until he assumed the office of president, Mr. Kauffman also acted as treasurer of the Square D Company. This office has now been taken over by W. S. Worcester, secretary of the organization.

Coming Conventions

American Institute of Electrical Engineers, annual winter convention, New York City, Jan. 28-Feb. 1; annual summer convention, Swampscott, Mass., June 24-28; F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Institute of Refrigeration, at Washington, May, 1929. Louis Baron, secretary, 203 West 13th St., New York City.

American Oil Burner Association, annual convention, Hotel Pennsylvania, New York City, April 9-11, 1929. For information, address the headquarters of the Association at 420 Madison Ave., New York City.

American Society of Heating and Ventilating Engineers, 35th annual meeting, Chicago, Ill., Jan. 28-31, 1929. A. V. Hutchinson, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers, spring meeting, Salt Lake City, Utah, July 1-4, 1929. Calvin Rice, secretary, 29 West 39th St., New York City.

Association of Iron and Steel Electrical Engineers, 25th annual convention, Pittsburgh, Pa., June 17-22, 1929. A. A. Stewart, secretary, Pittsburgh Steel Co., Monnessen, Pa.

Engineering Institute of Canada, annual general and professional meeting, at Hamilton, Ont., Feb. 13-15, 1929. R. J. Durley, secretary, 2050 Mansfield St., Montreal, Que.

Master Boiler Makers Association, at Atlanta, Ga., May 21-24. H. D. Vought, secretary, 26 Cortlandt St., New York City.

Midwest Power Conference and Exhibition, at Chicago, Feb. 12-16; G. E. Pfisterer, secretary, 53 West Jackson Blvd., Chicago.

World Engineering Conference, Tokyo, Japan, October, 1929. All correspondence should be addressed to the Secretary, World Engineering Conference, Nikon, Kogyo Club, Morunouchi, Tokyo.

TRADE CATALOGS

PIPE FITTINGS—Fittings of five different types are sketched, priced, and briefly described in a new fifteen-page bulletin put out by the Stockham Pipe & Fittings Company, Birmingham, Alabama.

NOZZLES — American Spiral Pipe Works, Taylor Forge Division, Chicago, is issuing a four-page folder descriptive of the new Taylor seamless forged-steel nozzles for boilers, pressure vessels and penstocks, which are made in sizes from 1½ to 24 inches.

PUMP GOVERNOR—The Northern Equipment Company, Erie, Pa., has issued a four-page leaflet describing its new Copes pump governor. A few generally descriptive paragraphs and several illustrations make up the leaflet.

AUTOMATIC CONTROL APPARATUS—Pulletin No. 500, published by the Leeds & Northrup Company, Philadelphia, Pa., gives in eight pages a description of automatic control apparatus for acid baths, the principal feature being the recording controller, a curve-drawing electrical instrument. General description, illustrations, and prices are some of the data given.

WATER SOFTENER—A 4-page leaflet has been issued by the Automatic Water Softener Company, Pittsburgh, Pa., illustrating an automatically controlled water-softening device. There are descriptive text, illustrations and diagrammatic sketches.

PULVERIZED COAL FIRING—The Kennedy-Van Saun Manufacturing & Engineering Corporation, Danville, Pa., recently issued Bulletin No. 12, dealing exhaustively with the subject of pulverized fuel firing. The bulletin contains 52 pages, covers every aspect of the subject, gives numerous illustrations on installations, several charts, and a number of cutaway drawings of the company's equipment.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.35@$2.40
Kanawha	Columbus	1.25@1.45
Smokeless	Cincinnati	2.25
Smokeless	Chicago	2.25
S. E. Kentucky	Chicago	1.30@1.60
Steam	Pittsburgh	1.60@1.70
Gas Slack	Pittsburgh	.75@.90
Big Seam	Birmingham	1.25@1.50
Anthracite (Gross Tons)		
Buckwheat	New York	$2.75@$3.25
Barley	New York	1.25@1.75

FUEL OIL

New York—Dec. 20, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4⅜c. per gal.; 36@40 deg., furnace, tank-car lots, 6½c. per gal.

St. Louis — Dec. 18, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.37½ per bbl. or 42 gal.; 26@28 deg., $1.42½ per bbl.; 28@30 deg., $1.47½ per bbl.; 30@32 deg., $1.52½ per bbl.; 32&36 deg., gas oil, 4.3c. per gal.; 38@40 deg., 5.4c.

Pittsburgh—Dec. 14, f.o b. local refinery, 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., 5½c. per gal.

Philadelphia—Dec. 11, 13@19 deg., $0.95@$1.02 per bbl. or 42 gal.; 22 deg. plus, $1.47@$1.53 per bbl.; 26@30 deg., $2.00@$2.06 per bbl.

Cincinnati — Dec. 17, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5½c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—Dec. 15, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 65c. per bbl.; 26@30 deg., 72½c. per bbl.; 30@32 deg., 97½c.@$1 per bbl.

Boston—Dec. 17, tank-car lots, f.o.b. 12@32 deg. Baumé, 4½c. per gal.; 28@32 deg., 5.6c. per gal.

Dallas—Dec. 15, f.o.b. local refinery, 26@30 deg., $1.20 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Anaheim — Anaheim Co-Operative Citrus Assn., is having plans prepared for the construction of a pre-cooling plant. Estimated cost $75,000. Hamm, Grant & Bruner, Inc., Ferguson Bldg., Los Angeles, are engineers.

Calif., Tracy — Tracy Irrigation Dist., J. C. Chrisman, Secy., authorized bond election Dec. 27, to vote $50,000 for the construction of pumping plants, etc. in connection with irrigation project.

Ill., Caire—Central Illinois Public Service Co., J. P. Clayton, Mgr., 1306 South 6th St., Springfield, will soon receive bids for the construction of an ice plant, here. Estimated cost $50,000.

Ind., Indianapolis — Bd. of Health, is having plans prepared for the construction of a power plant and service building at 960 Locke St. Estimated cost $450,000. C. R. Ammerman, 925 Continental Bank Bldg., is engineer.

Ia., Des Moines — Central Service Co., 100 East Maple St., will build addition to ice plant at 8th and New York Sts. Estimated cost $40,000. Work will be done by day labor.

Ia., Sioux City — Artificial Ice Co., J. Mallory, Mgr., 2021 Grandview Blvd., is having preliminary plans prepared for the construction of an ice plant. Estimated cost $135,000.

Md., Baltimore — Hospital for Women of Maryland, Lafayette and John Sts., awarded contract for the construction of a service building, boiler room, etc. at 139-43 Mosher St. to Frainie Bros. and Haigley, 19 West Franklin St.

Md., Cumberland — Celenese Corp. of America, 15 East 26th St., New York, N. Y., will soon receive bids for the construction of a turbine house here. Estimated cost $150,000.

Md., Baltimore — Maginnis & Walsh, Statler Bldg., Boston, Mass., Engrs., will receive bids until Dec. 29, for the construction of a boiler house at Roland and Belvidere Aves. for St. Mary's Seminary, Paca and St. Mary's Sts.

Mass., Bridgewater—Bd. of Education, will receive bids until Jan. 1, for the construction of a power plant at State Normal School. Estimated cost $80,000. R. D. Kimball Co., 6 Beacon St., Boston, is engineer.

Minn., Minneapolis — Northwestern National Bank, 4th St. and Marquette Ave., and L. S. Donaldson, 6th St. and Nicollet Ave., H. B. Waite, Frontenac Bldg., chn. of Bldg., Com. will receive bids until Jan. 3, for the construction of a 16 story bank and office building including steam heating system, elevators, etc. at Marquette Ave. between 6th and 7th Sts. Estimated cost $4,000,000. Graham, Anderson, Probst & White, 80 East Jackson Blvd., Chicago, Ill., are architects.

Missouri — Gasconade River Power Co., 1015 Baltimore Ave., Kansas City, is having preliminary plans prepared for the construction of a hydro-electric plant and dam 5,200 hp. capacity on Gasconade River in Phelps and Pulaski counties.

Mo., St. Louis — Park Plaza Building Corp., c/o Koplar Co., 265 Union Blvd., will build a 28 story apartment building at Kingshighway and Maryland Ave. Estimated cost $5,000,000. L. O. Schopp and E. J. Banman, 114 North 7th St., are architects. Brussel & Viterbo, Arcade Bldg., are engineers. Work will be done by separate contracts under the supervision of S. & N. Koplar.

Mo., St. Louis—Wagner Electric Co., 6400 Plymouth Bldg., is having plans prepared for the construction of a 120 x 380 ft. transformer building and 5 story, 80 x 120 ft. office, etc. Condron & Post, 53 West Jackson Blvd., Chicago, Ill., are architects.

N. J., Jersey City—Public Service Electric & Gas Co., 80 Park Pl., Newark, will soon award contract for the construction of a distribution plant and warehouse at 107-15 New York Ave., here. Estimated cost $250,000. Public Service Production Co., 80 Park Pl., Newark, is engineer.

N. J., Newark—F. Grad, 1023 Broad St., Engr., is receiving bids for the construction of an ice plant at 250-270 Badger Ave. for L. & K. Ice Corp., c/o engr. Estimated cost $40,000.

N. J. ,Newark—A. M. Greenfield, and M. Rachlen, 9 Clinton St., are having sketches made for the construction of a 20 story theatre and office building, etc. including steam heating system, etc. at 12-32 Lafayette St. and 870-880 Broad St. Estimated cost $5,000,000. F. W. Wentworth, 140 Market St., Paterson, is architect.

N. J., South Amboy — Jersey Central Power & Light Co., 20 South St., Asbury Park, is having plans prepared for the construction of a steam operated power plant 50,000 kw. capacity, here. Estimated cost $5,000,000. Electric Planning & Engineering Corp., 57 William St., New York, N. Y., is engineer.

N. Y., Brooklyn—Garfield Park Corp., A. W. Barler, Pres., 162 Remsen St., plans the construction of a 15 story apartment building on Garfield Pl. Estimated cost $1,000,000. E. Roth, 1440 Broadway, New York, is architect.

N. Y., New York—Bregman Bros., 1068 East Tremont Ave., plans the construction of a 6 story apartment building at Jerome Ave. and 165th St. Estimated cost $1,500,000. H. Ginsberg, 222 East 42nd St., is architect.

N. Y., Rochester—J. Jorastow, 176 Meigs St., is having plans prepared for the construction of an 8 story hotel including steam heating, ventilation and refrigeration systems, boilers, elevators, etc. on Cumberland St. Estimated cost $1,000,000. Philips & Scranton, Inc., 311 Alexander St., are architects.

Oklahoma—W. Hough & Co., Muskogee, are having preliminary plans prepared for the construction of a 40 ton raw water ice plant at Sapulpa, also a 50 ton ice plant at Muskogee. Estimated cost $60,000 and $75,000 respectively. Private plans.

Texas—Hunt Development Co., has been granted permit by the State Board of Engineers to construct five hydro-electric power plants and dams 16,000 hp. capacity on the Guadalupe River between Sequin and Gonzales. Estimated cost approximately $5,000,000. Private plans.

Tex., Barreda—Barreda Irrigation Dist., Brownsville, plans the installation of a pumping plant, etc. in connection with irrigation project, here. Estimated cost $925,000. V. L. Conrad, Brownsville, is engineer.

Tex., Mercedes—Central Power & Light Co., Frost Bldg., San Antonio, F. Ludden, Dist. Mgr., Mercedes, is receiving bids for the construction of a cold storage plant, here. Estimated cost $70,000. Private plans.

Ont., Hamilton — Toronto, Hamilton & Buffalo Ry. Co., is having plans prepared for the construction of machine shops, power house, etc. Estimated cost $1,000,000. R. L. Latham, is chief engineer.

Tex., Sinnett—City awarded contract for improvements to waterworks and distribution systems including well, pump house, etc. to Irick Construction Co., Plainview. Estimated cost $30,261.

Equipment Wanted

Compressor, etc. — L. W. Cooper, Clk., Madera, Calif., will receive bids until Jan. 7, for one 5½ x 5 portable compressor, etc.

Generator — Dept. of Mental Hygiene, Capitol, Albany, N. Y., will receive bids until Jan. 23, for an electric generator at Binghamton State Hospital, Binghamton, N. Y.

Motors—Bridge Pattern Works, 838 Main St., Cambridge, Mass., is in the market for five 3 hp., 550 v. a.c. motors, 3 ph., 60 cycle, 3,600 r.p.m.

Pump—J. Ray, Hatchville, Mass., is in the market for a gas or electric operated deep well pump (45 ft.).

Pumping Equipment, etc. — City of Uvalde, Tex., is receiving bids for the purchase and installation of electric, oil or coal burning pumping equipment, etc. for proposed waterworks improvements. Estimated cost $75,000.

Industrial Projects

Fla., Jacksonville — GAS COMPRESSED PLANTS — Linde Air Products Co., subsidiary of Union Carbide & Carbon Corp., 30 East 42nd St., New York, N. Y., awarded contract for the construction of an electrically operated plant here, to O. P. Woodcock Construction Co., Lutz Bldg., also plans a 2 story plant at Portland, Ore.

Ind., Evansville — AUTOMOBILE FACTORY — Graham Bros., awarded contract for a 1 story automobile factory to C. Kanzler & Son, Furniture Bldg. Estimated cost $250,000.

Louisiana — OIL REFINERY and BY-PRODUCTS PLANT — Shell Union Oil Co., 65 Broadway, New York, N. Y., plans a $30,000,000 stock issue for extensions and improvements to oil refinery and by-products plants at Missouri, Louisiana and California. Private plans.

Mich., Pontiac—FACTORY and HAMMER SHOP—American Forging & Socket Co. is having plans prepared for the construction of a 100 x 125 ft. factory, and 55 x 80 ft. hammer shop on Branch St. Estimated cost $55,000. Owner is in the market steam heating, electric motors and power hammers.

Mo., North Kansas City — LACQUER PLANT — Cook Paint & Varnish Co. awarded contract for a 3 story, 60 x 113 ft. lacquer plant to Collins Construction Co., Davidson Bldg., Kansas City. Estimated cost $50,000.

N. J., Elizabeth—GAS ACCUMULATOR FACTORY — American Gas Accumulator Co., Newark Ave., awarded contract for a 1 story, 60 x 140 ft. addition to factory, to D. O. Evans, 1443 North Broad St., Hillside. Estimated cost $40,000.

N. J., Hillside—TOY TRAIN PLANT—The Lionel Corp., 605 South 21st St., Irvington, awarded contract for a 1 and 2 story, 390 x 622 ft. factory and warehouse on Sager Pl., here, to Austin Co., 120 Broadway, New York, N. Y. Estimated cost $140,000.

N. J., Paterson—BATTERY MANUFACTURING PLANT—Ajax Battery Corp., c/o J. De Rose, 119 Ellison St., Archts., will build a 1 story, 100 x 100 ft. battery factory at Turni and Main Aves. Estimated cost $40,000.

N. J., Picatinny — ADMINISTRATION BUILDING, ETC.—Constructing Quartermaster, U. S. Army, awarded contract for the construction of an administration building, thirteen buildings in laboratory area, twenty-one buildings in melt loading area and three buildings in shop area to Van Asdlen Construction Co., 1600 Arch St., Philadelphia, Pa. Estimated cost $793,516.

O., Canton—BEARING FACTORY—Timken Roller Bearing Co., Dueber Ave., awarded contract for a 1 story, 100 x 150 ft. factory for the manufacture of automobile bearings on Harrison Ave. S. W., to Melbourne Construction Co., 116 Brant Bldg. Estimated cost $50,000.

O., Cleveland — VULCANIZING MACHINERY FACTORY—James C. Heintz, 3738 West 143rd St., awarded contract for a 1 story, 80 x 156 ft. addition to factory at 3738 West 143rd St. to Bolton-Pratt Construction Co., 7113 Euclid Ave. Estimated cost $60,000.

O., Toledo—FOUNDRY ADDITION—Industrial Steel Casting Co., Millard Ave., awarded contract for a 1 story, 140 x 180 ft. addition to foundry, to Comte-Naumann Co., 912 Summit Ave. Estimated cost $200,000. Steam heating, moulding machines, cranes, and general foundry equipment will be installed.

Pa., Pittsburgh—BOX FACTORY—F. J. Kress Box Co., 2930 Liberty Ave., will soon award contract for a 1 and 2 story, 300 x 400 ft. factory at 28th St. Estimated cost $450,000. Private plans.

Ont., Windsor — STEEL PLANT — Swedish Crucible Steel Co., N. Olson, Mgr., McDougall St., is having plans prepared for addition to plant. Estimated cost $50,000.

POWER

With which are consolidated *The Engineer* and the *Stationary Engineer*

Volume 68 Number 26

December 25, 1928

POWER SERVICES *In This Issue*

Combustion 1045
Electrical Transmission. 1048
Elevators 1034
Generation 1030, 1041
Lubrication 1036
Maintenance 1038
Metals 1028
Oil Engines 1036
Process Steam 1030
Refrigeration 1038

FRED R. LOW, *Editor*

P. W. SWAIN
Managing Editor
G. L. MONTGOMERY
L. D. BLAKE
F. A. ANNETT
L. H. MORRISON
Associate Editors
THOMAS WILSON (Chicago)
Western Editor
F. L. BEERS
A. L. COLB
R. B. PURDY
Assistant Editors

IRVING FELLNER
Publishing Director

McGRAW-HILL PUBLISHING COMPANY, INC.
Tenth Ave., at 36th St.
NEW YORK, N. Y.
Cable Address: "Machinist, N. Y."

JAMES H. MCGRAW, *Chairman of the Board*
MALCOLM MUIR, President
JAMES H. MCGRAW, JR., Vice-President and Treasurer
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
HAROLD W. MCGRAW, Vice-President
C. H. THOMPSON, Secretary

NEW YORK Dist. Office, 285 Madison Av.
WASHINGTON, National Press Building
CHICAGO, 7 South Dearborn Street
PHILADELPHIA, 1600 Arch Street
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie St., E. C. 4

Publishers of
Electrical World
American Machinist
Electrical Merchandising
Engineering and Mining Journal
Chemical and Metallurgical Engineering
Bus Transportation
Power
Coal Age
Radio Retailing
Electric Railway Journal
Engineering News-Record
Food Industries
Construction Methods
Electrical West
American Machinist—European Edition

SUBSCRIPTION PRICES: United States and its possessions, Canada, Mexico, $3 a year. Central and South American countries, $5 a year. All other foreign countries, $8 a year. Single copy, 15 cents. Published weekly. Entered as second-class matter, December 20, 1910, at the Post Office, New York, N. Y., under the act of March 3, 1879. Printed in U.S.A.

Copyright, 1928, by McGraw-Hill Publishing Company, Inc.

CHANGE OF ADDRESS
Subscribers are requested to send both the old address and the new address when they move to a new address.

Member Audit Bureau of Circulations.
Member Associated Business Papers.

Number of Copies Printed This Issue, 28,435

Contents:

Plant Built Out of Its Own Savings - - - - - - - - - 1030
BY C. R. AHLQUIST
The Gates Rubber Company, of Denver, Colorado, has solved an interesting problem without cost to itself.

Electric Elevators Replace Hydraulics - - - - - - - - 1034
BY A. J. DIEDRICH
Elevator change in office building saved about 18 per cent of operating cost and improved the service.

Choosing Lubricating Oil for a Diesel - - - - - - - - 1036
BY J. W. PETERSON
Practical advice to the man who must maintain service, preserve the equipment and keep down cost.

Stopping Corrosion by Hydrogen-Ion Control - - - - 1038
BY F. R. MCCRUMB
Hydrogen-ion control, the key to many corrosion problems, is not as difficult as it sounds.

Setting Poles with Dynamite - - - - - - - - - - - 1040
The earth rumbles slightly and a pole slides down gently into the ground for ten feet or twenty.

New Boiler Plant of Illinois Glass Company - - - - - 1041
BY A. J. TIGGES
Modern design and provision for expansion characterize boiler plant that replaced hand-fired plant.

160,000-Kw. Turbine at Hell Gate - - - - - - - - - 1044
Artist's sketches showing construction of American Brown-Boveri machine soon to start operation at Hell Gate.

Heat Balance Spots Controllable Losses - - - - - - - 1045
BY A. A. POTTER AND H. L. SOLBERG
Shows how to compute those combustion losses that must be watched to keep up efficiency.

Maintenance of Circuit Breaker Operating Mechanism - 1048
BY E. K. READ
How to replace the closing coil on the solenoid operating mechanisms of oil circuit breakers.

Editorials - - - - - - - - - - - - - - - - - - - 1028
Right Out of the Plant - - - - - - - - - - - - - 1049
As the Other Fellow Sees It - - - - - - - - - - - 1051
What's New in Plant Equipment - - - - - - - - - 1053
The Engineer and His Function - - - - - - - - - - 1056
Pumped Water Used to Operate Hydro-Electric Plants - 1058
Events and Men in Power's Field - - - - - - - - - 1060
New Plant Construction - - - - - - - - - - - - - 1064

Prevents Plant Shutdowns

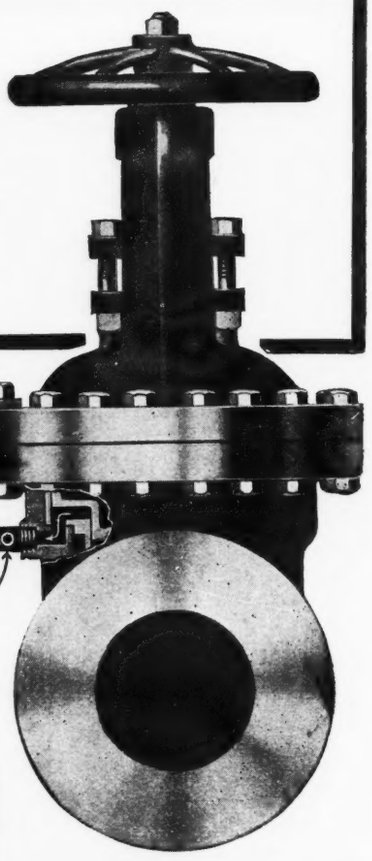
Overspeeding is a common cause for disastrous turbine and engine accidents. Why take this risk, when it is so easy to prevent excess speeds by means of

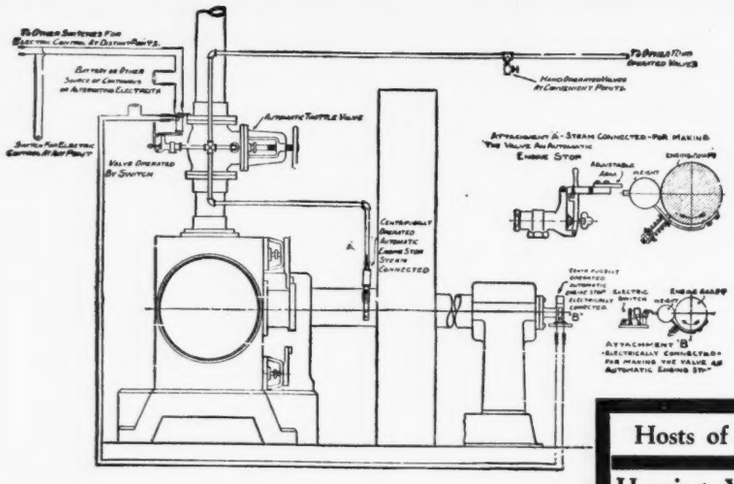
GOLDEN-ANDERSON

Pat. Cushioned Throttle and Engine Stop Valves

Four ways to operate the valves.

1. Automatically by overspeeding, which causes centrifugal force to distend shaft attachment, causing steam pilot valve to trip or electric solenoid to operate which will instantly close the valve and shut off the flow of steam.
2. Electrically from any number of service stop stations installed in the plant. Pressing an electric button instantly closes the valve.
3. Emergency—by steam pipe connections. Release of pressure by small hand valves to atmosphere instantly closes the valve.
4. Hand—by hand wheel like ordinary stop valve.




Automatic Throttle Valve
Valve Operated By Switch
Centrifugally Operated Automatic Engine Stop Steam Connected
Attachment 'B' Electrically Connected for making the valve an Automatic Engine Stop

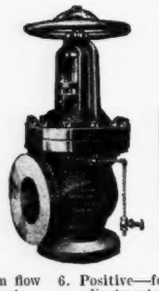
Small Branch Pipes Can Be Run to Engineer's or Master Mechanic's Office or to Engine to Operate Independent of Automatic Pilot Valve.

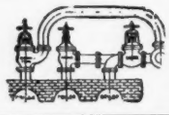
Hosts of References

Heaviest Valves Made

THE LARGE IRON and STEEL CORPORATIONS ORDER

"4575"





DOUBLE EXTRA HEAVY VALVES
"Every Valve sold with a Positive Guarantee."

"No Shutdown when Boiler Tube Bursts"

GOLDEN-ANDERSON
Pat. Automatic Double Cushioned Non-Return Valves

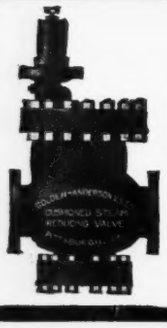
1. Prevent expensive shutdowns due to reversal of steam flow.
2. Instantly close and isolate a boiler when a tube ruptures.
3. Simultaneously shut off the steam flow from all boilers when a pipe bursts.
4. Automatically cut a boiler into the line.
5. Prevent back flow of steam into a cold boiler.
6. Positive—foolproof, No springs or adjustments to be made.
7. Can be tested in service.
8. Double Corliss dashpot that cushions in opening and closing.
9. Cannot spin, stick or chatter.

GOLDEN-ANDERSON
Patent Automatic Cushioned Controlling Float Valves

1. They carry a constant water level in feed water heaters by perfectly controlling the flow of makeup water.
2. Operated by protected, enclosed copper float.
3. Cushioned by both air and water.
4. Operate without hammering, sticking or chattering. No metal-to-metal seats. Made angle or straightway. Sizes 1-in. to 24-in.

GOLDEN-ANDERSON
Pat. Automatic Cushioned Water Float Valves

1. Automatically maintain uniform water levels in tanks, standpipes, etc.
2. Instantly adjusted to operate quickly or slowly.
3. Floats swivel to any angle—most satisfactory float valves known.
4. No metal-to-metal seats—no water hammer or shock.
5. Cushioned by Water and Air. Sizes ½-in. to 24-in.



GOLDEN-ANDERSON
Patent Automatic Cushioned Steam Pressure Reducing Valves

1. Maintain a constant reduced pressure.
2. Thoroughly cushioned.
3. No hammering, chattering or sticking.
4. No auxiliary valves or small by-passes to clog up.
5. No wire drawing.
6. Only one adjustment from the outside.
7. Double, extra heavy throughout—practically indestructible.

GOLDEN-ANDERSON
Patent Automatic Controlling Altitude Valves

Automatically maintain uniform water level in tank, standpipe or reservoir. No floats or fixtures to freeze.

Sizes to 24-in.

No Valves in Tank

Golden-Anderson Valve Specialty Co., 1317 Fulton Bldg., Pittsburgh, Pa.

Gold Medal awarded to Connery & Company at the Philadelphia Sesqui-Centennial "For Improved Expansion Compensating and Stiffened draft flues and dampers."

Another installation of Connery's improved expansion stiffener construction for flues and uptakes at

Virginia Cellulose Co., Hopewell, Va.

Engineer: Hercules Powder Co., Wilmington, Del.

Fifty years' experience in the design and erection of flues, uptakes, boiler breechings and similar work, has resulted in the four newest Connery developments—outstanding contributions to modern power plant design. And yet—"Connery Construction costs no more than ordinary types."

Connery's Improved Expansion Stiffener

Accordion Type Stiffener consists of "V" shaped projections pressed into the sheets while cold, utilizing the bellows principle, the most feasible construction known to provide for contraction and expansion. Electrically welded, air- and moisture-tight construction eliminates buckling, warping and internal corrosion.

Connery's Improved Stack Connection

This rigid electrically welded steel form uses the "V" shaped expansion stiffener to provide for connection of stack to breeching, thereby eliminating the necessity for other prepared forms while building concrete or brick stack. It also provides for expansion both vertically and horizontally. When grouted in stack it forms a seal eliminating any leakage at stack opening.

Connery's Air Cooled Damper

Damper is constructed of two steel plates supported upon a central pipe, which extends through damper to permit continuous flow of cool air. This reduces the temperature of the plates, thereby reducing the possibility of warping. The supply of air should be obtained by means of forced or induced draft, dependent upon plant conditions.

Connery's Adjustable Covering Attachment

This consists of a regular bolt threaded at one end and flattened on other end. ⅜-in. holes are provided, through which to pass suitable sized rods, so as to permit the asbestos to be tied at any distance from the breeching proper. These clips are readily applied during assembly and are especially adapted for the improved construction handled by this company.

Our engineers will be glad to cooperate in the design and erection of Connery Construction.

Get our Booklet for full particulars.

WE RECOMMEND

TRUFILM

Heat Resisting Paint

Manufactured by

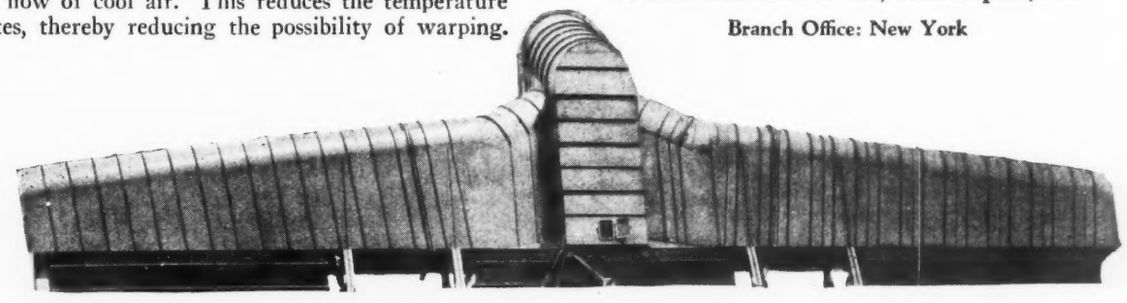
PASCHALL VARNISH CO., Phila., Pa.

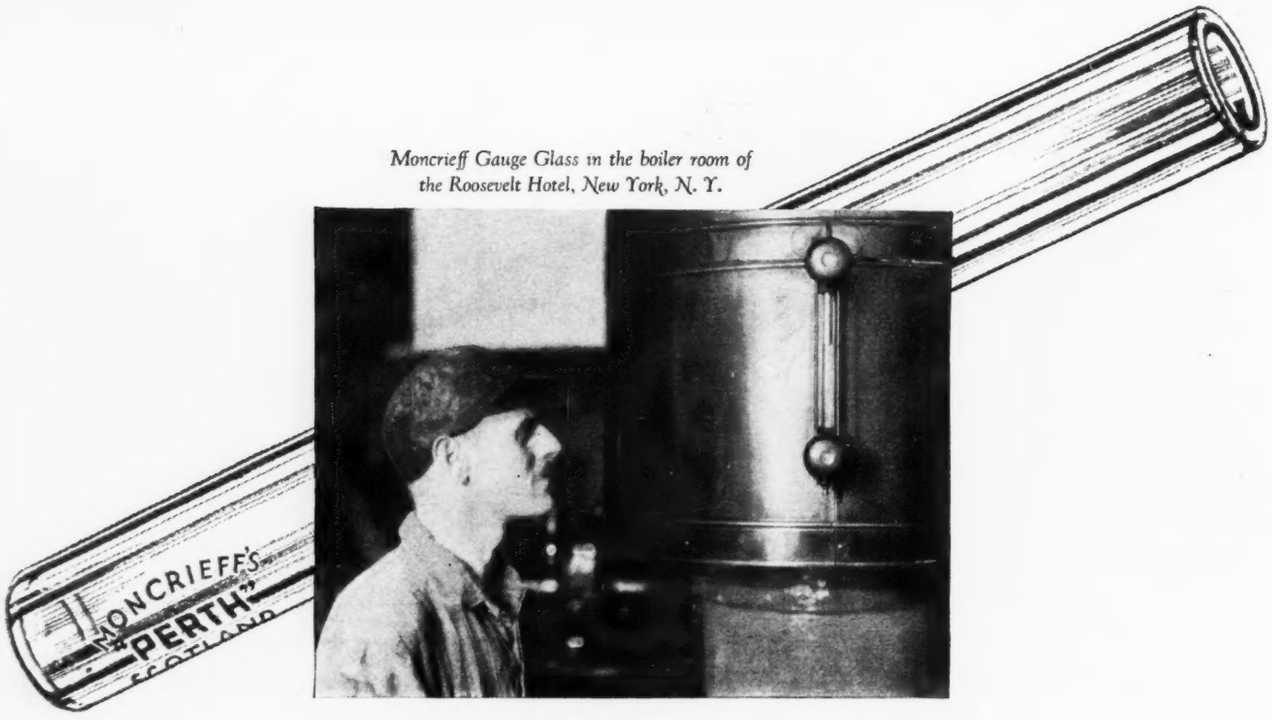
Home Office and Plant:

CONNERY & COMPANY, INC.

Second and Luzerne Sts., Philadelphia, Pa.

Branch Office: New York





Moncrieff Gauge Glass in the boiler room of the Roosevelt Hotel, New York, N. Y.

Choose from this list of MONCRIEFF SCOTCH GAUGE GLASSES

PERTH

For standard steam pressures up to 150 pounds

UNIFIC

For working steam pressures up to 500 pounds (Have withstood 750 pounds)

BEACON RED

Having an interlayered red stripe to emphasize the water line, will stand 150 pounds steam pressure

MONAMEL

Having a super-imposed red stripe to emphasize the water line. Will stand 250 pounds pressure

PRISMATIC

A flat clear glass with prisms. Specially toughened

PROTECTOR SLIDES

A flat clear glass. Specially toughened. Used on some gauges for protection of tubular glass and to absorb shocks

GAUGE GLASS STRIPS

A flat clear glass without prisms. Specially toughened

JENKINS BROS. PERTH GAUGE GLASS MONCRIEFF MAKER PERTH SOLE AGENTS FOR UNITED STATES MADE IN SCOTLAND

The right reading *at a glance*

A second glance is never needed to determine the water level in a Moncrieff Gauge Glass. A Moncrieff is clear and stays clear.

Because of a combination of transparency and toughness, these genuine Scotch gauge glasses have made many friends in America. For over 60 years, Moncrieff Glasses have held the confidence of hundreds of engineers, and have steadily enlarged their circle of users.

Long experience, exclusive formulae—all play their parts in the manufacture of these glasses by John Moncrieff at Perth, Scotland. And Moncrieffs, as shown in the gauge glass guide at the left, are furnished in a variety which affords a wide range of choice to fit the service.

JENKINS BROS. . . . . *Sole U. S. Agents*

80 White St., New York, N. Y.
133 N. Seventh St., Philadelphia, Pa.
524 Atlantic Ave., Boston, Mass.
646 Washington Blvd., Chicago, Ill.

MONCRIEFF
Genuine Scotch
GAUGE GLASSES

Around *the* World with COPES

In almost every civilized country in the world, the COPES System of Boiler Feed Control is saving money for power plant operators. Because the COPES System is designed exactly for the conditions of the individual plant— in cold Spitzbergen or hottest India; Japan or Australia.

From Zuckerfabrik & Raffinerie Aarberg, A.-G., at Aarberg, Switzerland, comes this letter:

> *"We are satisfied with the four* COPES *Feed Water Regulators. They are reliable and the cost of their installation has been repaid in one working period."*

Your plant conditions are different from those in any other plant. Therefore, we cannot guarantee the definite amount of money that the COPES System will save for you. But we do know that a COPES installation will provide the most modern method obtainable for regulating the flow of your boiler feed water. And modern methods are surely more efficient than out-of-date ones— and, therefore, more economical.

Write now for facts and descriptive literature.

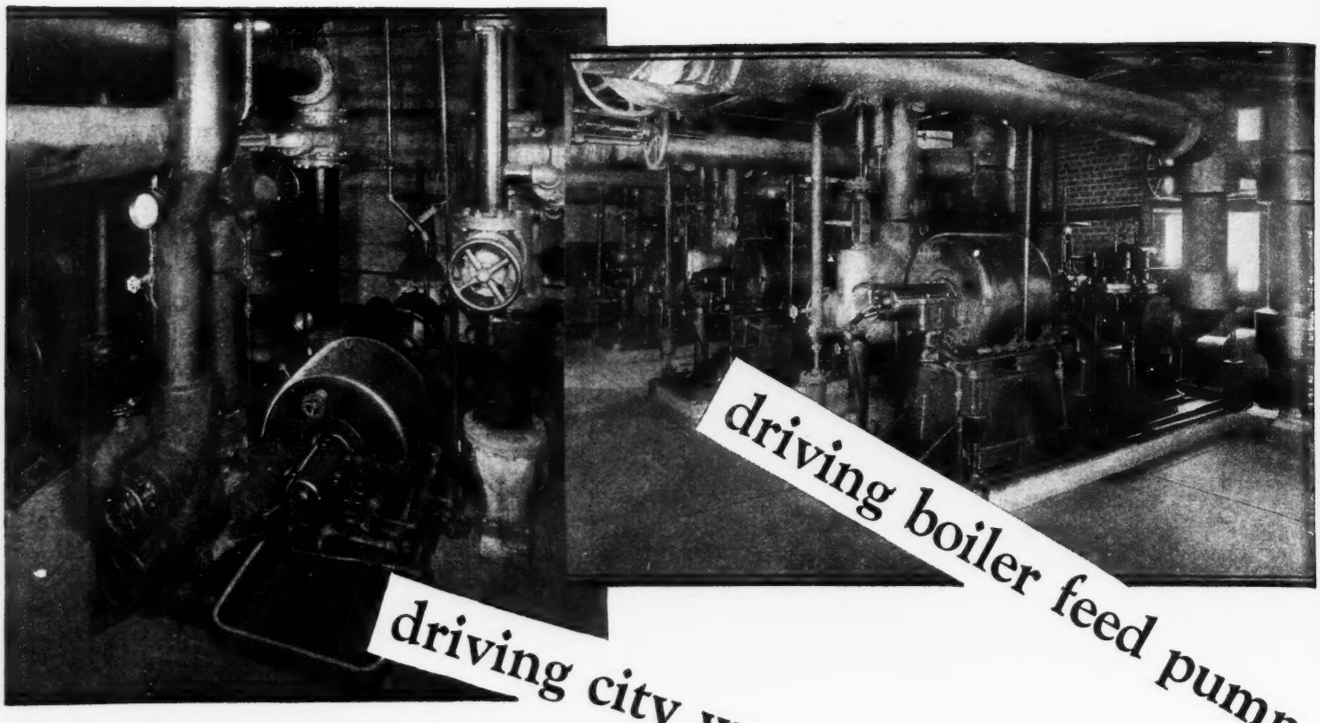
That All the World Might Know

Because of the world-wide interest in the COPES System of Boiler Feed Control, complete COPES literature, including installation directions, is printed in ten languages—English, French, Dutch, Danish, Swedish, Russian, German, Italian, Spanish and Japanese. Constant contact with engineers of all these nations enables COPES engineers to keep the COPES System abreast of modern operating conditions in power plants throughout the world.

Northern Equipment Co.
1241 Grove Drive
Erie, Pa.

Branch Plants in Canada, England, France, Germany, Italy and Austria. Representatives Everywhere.

COPES
SYSTEM OF BOILER FEED CONTROL



THE PHILADELPHIA
ELECTRIC COMPANY

selects ten ELLIOTT TURBINES

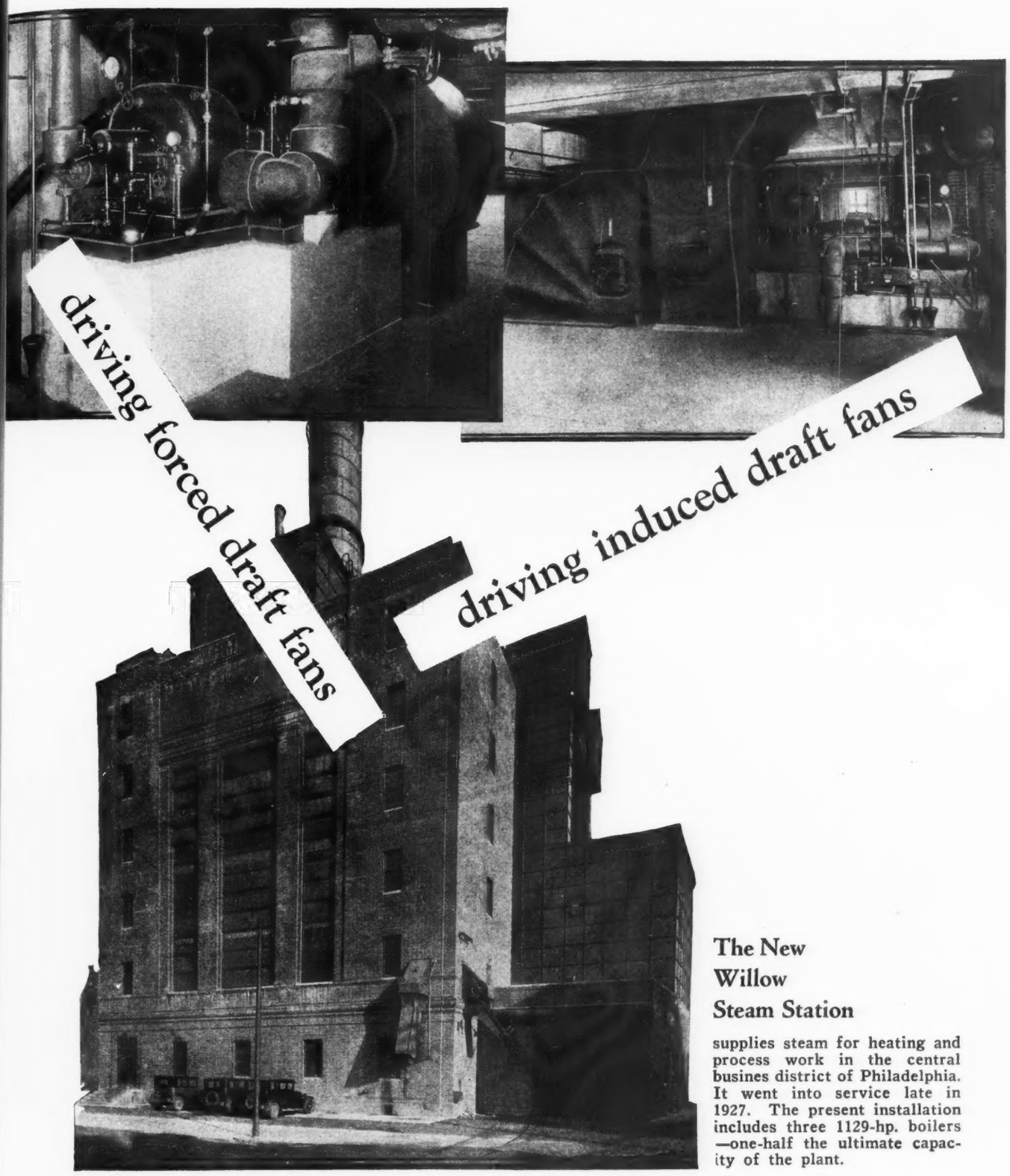
for

Willow Steam Station

Four of the Elliott Turbines driving pumps are direct connected; six turbines drive fans through Elliott Reduction Gears.

The selection of Elliott equipment by Philadelphia Electric engineers was made only after careful analysis, and indicates an appreciation for the qualities of high efficiency, sturdy ruggedness, and accessibility.

ELLIOTT COMPANY products include
Steam Turbines, Steam Engines, Generators and Electrical Machinery, Condensers, Air Ejectors, Deaerators, Feed Water Heaters, Separators, Filters, Valves etc.



The New Willow Steam Station

supplies steam for heating and process work in the central busines district of Philadelphia. It went into service late in 1927. The present installation includes three 1129-hp. boilers —one-half the ultimate capacity of the plant.

H-528

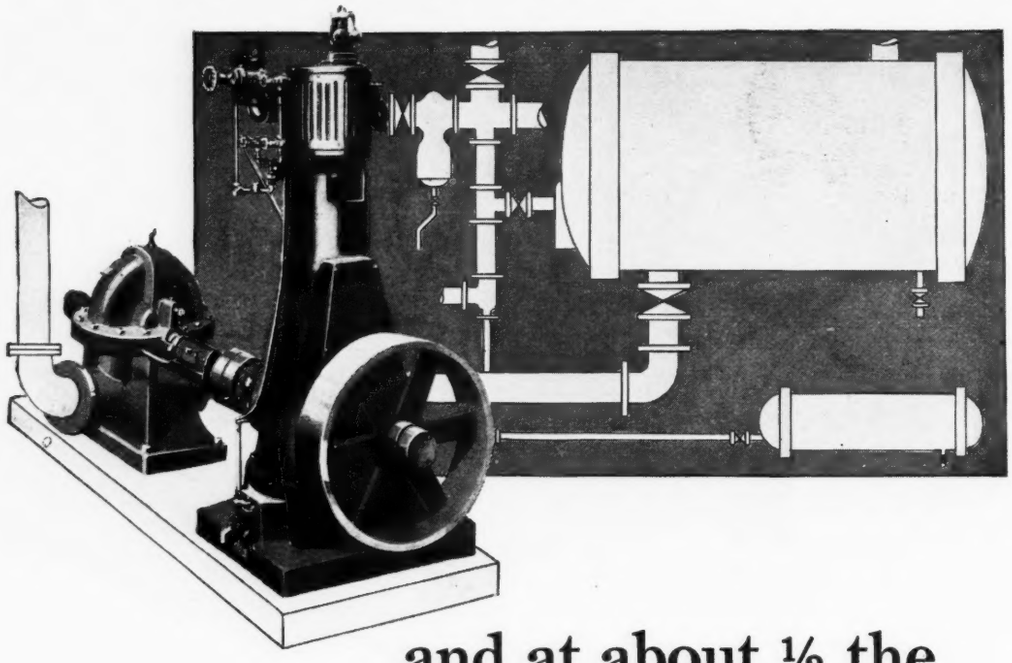
ELLIOTT COMPANY

PITTSBURGH, PA.

General Sales Offices **JEANNETTE, PA.**

District Offices in principal cities

Pumping highly viscous liquids with less steam . . .



and at about ½ the cost—because the exhaust steam from a TROY ENGINE can be used to heat the liquid

This is a very common set-up in the Process Industries—pumping liquids requiring process heating. Many engineers do *not* know that a Troy Engine will do both jobs at practically the cost of one of these operations. This is how it works:

A Troy Engine is efficient as a source of power for pumps, blowers and all plant auxiliaries up to 200 b.h.p. It is capable of infinite speed variation. It is a compact, rugged drive, very economical and reliable when operating against moderate back pressure from 5 to 15 lb., which makes the available exhaust steam ideal for process heating, drying, vulcanizing, etc. This results in "double efficiency," which will quickly pay back the cost of the installation and will continue to pay high dividends for years.

Why not investigate the full benefit of this set-up in your own plant? Our engineers are at your service for consultation. Ask us how a Troy Engine can help you reduce your operating cost.

Manufacturers, Attention!

If you run a separate department for producing steam engines to drive your machinery, we want you to compare our contract prices with your departmental costs. Troy Engines may give you more manufacturing space at no extra cost.

TROY ENGINE & MACHINE CO.
TROY, PA.

Chicago Office: 118 West Ohio St.
Riley Engineering Co. of Canada, Ltd. 360 Dufferin St., Toronto, Canada

TROY *Self-Oiling* STEAM ENGINES

Just a heater was not enough for

KELLY-SPRINGFIELD

A feed water heater was required at the Kelly-Springfield plant, at Cumberland, Maryland, but Mark W. Roe, Engineer, wanted more than just a heater. Ample water storage and filtering were of major importance.

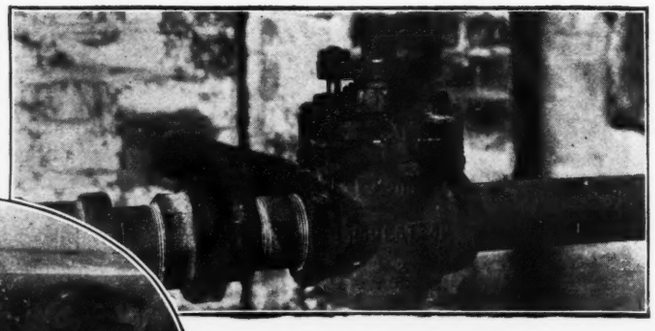
A 60 inch Swartwout Feed Water Heater with four spacious water storage units and two steam compartments was chosen to handle the hourly input of 600,000 pounds. It supplies hot water for eight boilers; six of 750 H. P. and two of 925 H. P., all of which run at 275 per cent rating.

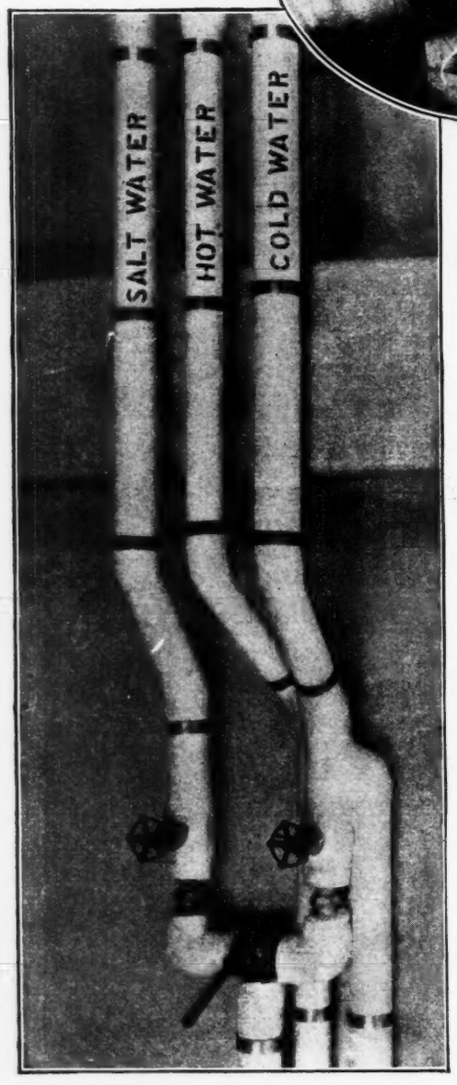
They think of more than tires at Kelly-Springfield . . . and thoughts relative to efficiency in power plant equipment are synonymous with Swartwout.

THE SWARTWOUT COMPANY
18511 Euclid Avenue, Cleveland, Ohio

Swartwout
Power Plant Equipment

At the gateway of the nation





Pumping Station on Ellis Island gives HOMESTEAD Quarter-Turn Valves Severe Use

Any Engineer will recognize the severity of valve service where salt and fresh water are handled alternately. Homesteads, like those shown, are doing this for Ellis Island and many of them have been in constant service for more than three years.

The plant has approximately 32 Homestead Valves ranging from 2 inches to 3 inches in size.

The carefully ground metal-to-metal seating surfaces, patented cam action providing positive closing, and the rigid inspection and thorough tests to which these valves are subjected before leaving the factory, are factors responsible for Homesteads giving better and longer service.

Let us show you what Homesteads can do on your lines. There's a type, size and style for practically any condition. Write for catalog or ask for representative to call.

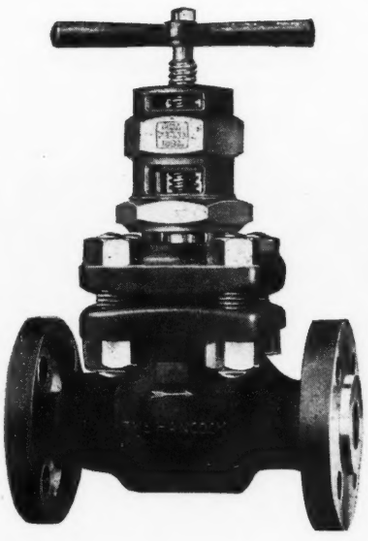
HOMESTEAD VALVE MANUFACTURING CO.

P. O. Box "H", Coraopolis, Pa.

HOMESTEAD VALVES

QUARTER TURN VALVES:
STRAIGHT WAY
THREE WAY
FOUR WAY
LUBRICATED TYPE
ROUND OPENING REFINERY

PROTECTED SEAT VALVES:
HYDRAULIC (B & O. PAT.) OPERATING
REMOTE CONTROL
GLOBE
ROSS AIR SHUT-OFF VALVE
HOVALCO BLOW-OFF VALVE



HANCOCK VALVES

Maximum Efficiency

Hancock Valves are big contributors toward maximum efficiency in power plant operation. Their absence of leaky seats, wire-drawn discs, distortion of valve body and faulty packing boxes helps the operating engineer keep his steam costs down to a minimum. In many plants where other valves have been in service only two to three *weeks*, Hancock Valves have gone for over two *years* without regrinding or renewing seats. If you want Hancock performance, install Hancock Valves.

Bulletins on request.

HANCOCK VALVES

Primarily designed for drain or throttling pressure service, and universally used for other service—including saturated and superheat and boiler feed lines. "Hancock Quality" assures high quality material—high quality workmanship—and rigid inspection.

Cast Steel Valves

Globe, Angle and Check Valves
Range 250 lb.—750° F. Screw bonnet type
400 lb.—750° F. Flange bonnet type
600 lb.—750° F. Flange bonnet type

Flat Seat Standard—45° bevel seat furnished, when required.

Forged Steel Valves

250 lb.—450 lb.—750° F.
Union bonnet type
400 lb.—600 lb. 750° F.
Flange bonnet type

Flat seat Standard—45° bevel seat furnished when required.

Special Features

Friction is reduced to a minimum and drop in pressure through valve is eliminated by Hancock design.

Seats and discs are made of a special high nickel-alloy, a non-corrosive metal having high Brinell hardness and high erosive resisting qualities.

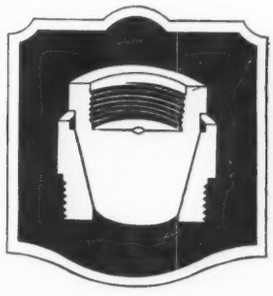
Cast steel bodies and yokes are made from high grade, electric furnace steel.

Forged steel valves are made from high grade forging steel conforming to A.S.T.M. forging specifications. Bolt material conforms to A.S.T.M. Specifications A96-27, as approved by American Engineering Standards Committee.

All Hancock valves are designed and tested to insure a large factor of safety.

Cone Seat

The cone and seat ring are ground and lapped at the same degree with utmost precision, producing a PREFECT FIT. From that moment the matched cone and seat ring are never separated. This is one of those many refinements that combine to make Hancock Valves supreme in their field.



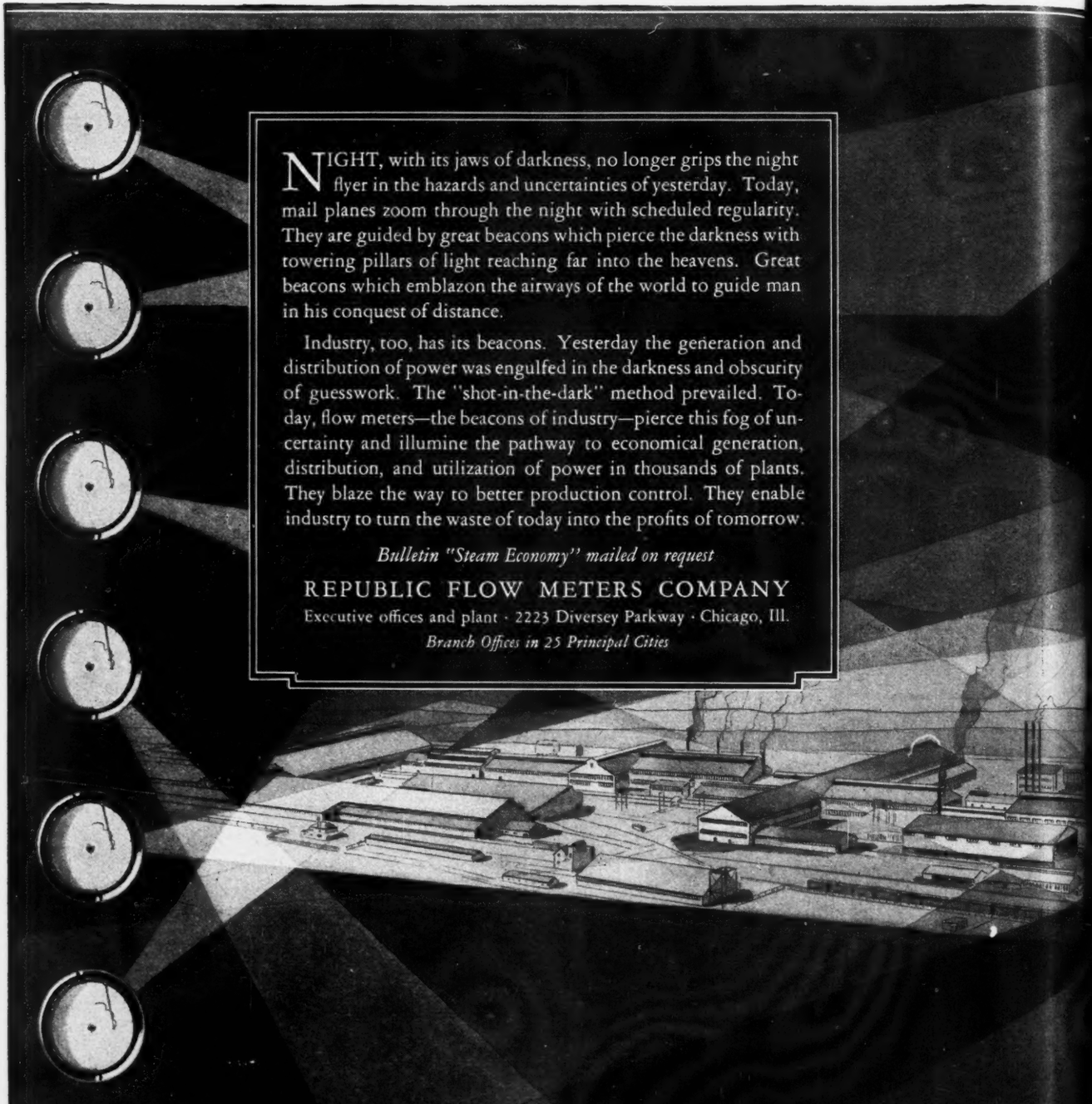
CONSOLIDATED ASHCROFT HANCOCK COMPANY, Inc.

Subsidiary of Manning, Maxwell and Moore, Inc.

100 E. 42nd ST., New York City

Western Sales Office - 29 N. Jefferson St., Chicago

BEACONS OF



NIGHT, with its jaws of darkness, no longer grips the night flyer in the hazards and uncertainties of yesterday. Today, mail planes zoom through the night with scheduled regularity. They are guided by great beacons which pierce the darkness with towering pillars of light reaching far into the heavens. Great beacons which emblazon the airways of the world to guide man in his conquest of distance.

Industry, too, has its beacons. Yesterday the generation and distribution of power was engulfed in the darkness and obscurity of guesswork. The "shot-in-the-dark" method prevailed. Today, flow meters—the beacons of industry—pierce this fog of uncertainty and illumine the pathway to economical generation, distribution, and utilization of power in thousands of plants. They blaze the way to better production control. They enable industry to turn the waste of today into the profits of tomorrow.

Bulletin "Steam Economy" mailed on request

REPUBLIC FLOW METERS COMPANY

Executive offices and plant · 2223 Diversey Parkway · Chicago, Ill.

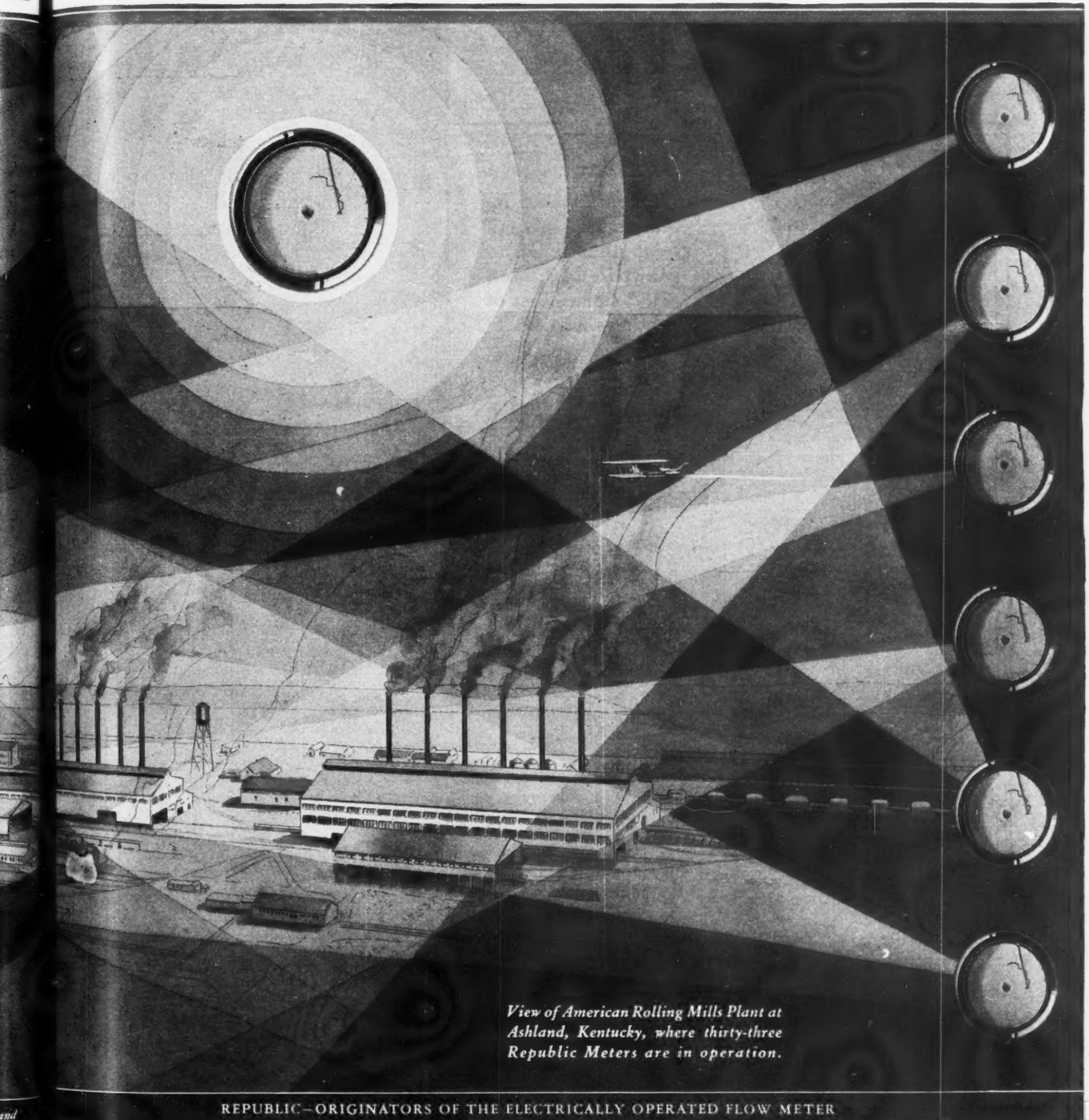
Branch Offices in 25 Principal Cities

DOMINION FLOW METERS CO., *Toronto, Canada* ELEKTROFLO, *Berlin, Germany* ELECTROFLO METERS CO., *London, England*

Republic Meters

The REPUBLIC

INDUSTRY



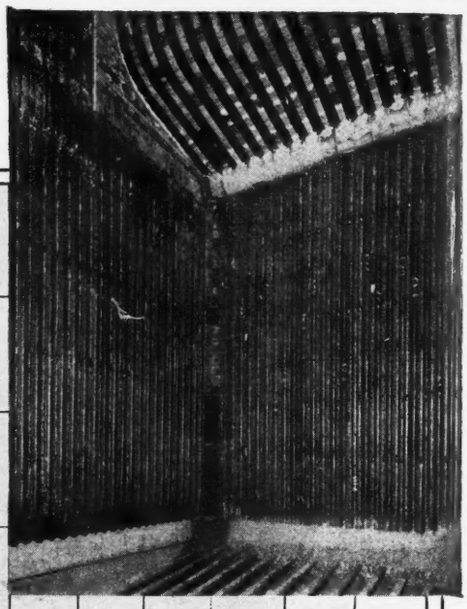
View of American Rolling Mills Plant at Ashland, Kentucky, where thirty-three Republic Meters are in operation.

REPUBLIC—ORIGINATORS OF THE ELECTRICALLY OPERATED FLOW METER

FLOW METERS

Republic Meters

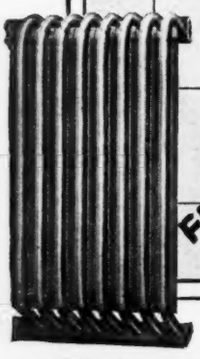
Water cooled



C-E Fin Furnace installed in a prominent steam heating plant in the East. 4,132 square feet of heating surface.

C-E Fin Furnace of 90 square feet heating surface is installed in an Oil Refinery in the Middle West.

FROM 90 TO 4132 SQ. FT. OF HEATING SURFACE



COMBUSTION

FURNACES

IN a Mid-west oil refinery, a C-E Fin Furnace of only 90 square feet of heating surface is in service—the smallest ever installed. At the other extreme are the gigantic boilers of a prominent steam heating plant in the East where each unit is equipped with a C-E Fin Furnace of 4,132 square feet.

Within this range are included hundreds of plants of all sizes and types—each profiting by the installation of C-E all-metal, bare-tube furnace walls. In these plants, refractory failures are at an end because refractories are eliminated—boilers are operating at increased ratings and at higher efficiencies, for the C-E Fin Furnace is a steam generating furnace connected into the boiler circulation.

The size of an installation is never an accurate yardstick for measuring the importance of C-E Water-cooled furnaces. The opportunities for effecting economies are relatively the same in the small plant and the large plant—and we are equally interested in both.

The new C-E Fin Furnace catalog illustrates and describes the C-E Water-cooled Furnace and its application. May we send you a copy?

COMBUSTION ENGINEERING CORPORATION

International Combustion Building — 200 Madison Ave., New York

A Subsidiary of
INTERNATIONAL COMBUSTION ENGINEERING CORPORATION

POWER PLANTS

From 70 H. P. to 1,000,000 KW. ult.

BOILERS

From 70 H. P. to over 4,000 rated boiler horsepower.

PULVERIZED FUEL

For pulverizing 600 lbs. to 60,000 lbs. of coal per hour.

STOKERS

For burning 250 lbs. to 40,000 lbs. of coal per hour.

WATER COOLED FURNACES

From 90 sq. ft. to 4,132 sq. ft. of water wall surface.

AIR PREHEATERS

From 217 to 62,942 sq. ft. of heating surface.

ENGINEERING

JEFFERSON UNIONS

No More Unsightly Seepage

Seepage does not appear sooner or later where Jefferson Unions are installed. *It is permanently shut off.* Furthermore, the waste of fuel and labor due to the accumulation of these leaks (through ordinary unions) is also shut off where Jeffersons are installed.

The brass to iron seating surfaces ground together in pairs to form a completely dependable, tight joint. The female brass ring is securely anchored in a recess, entirely out of contact by the steam, water, oil, gas, air or other fluid passing through the pipe. It cannot become loose or give trouble. The surfaces cannot rust together.

There is a wide choice in Jefferson Unions—a union for every purpose in piping.

Your dealer can supply you. We will be pleased to help you solve any union problem.

JEFFERSON UNION CO.
LEXINGTON, MASSACHUSETTS
General Sales Office:
11 West 42nd St., New York City

Jefferson Features

Made of Air Refined Malleable Iron.

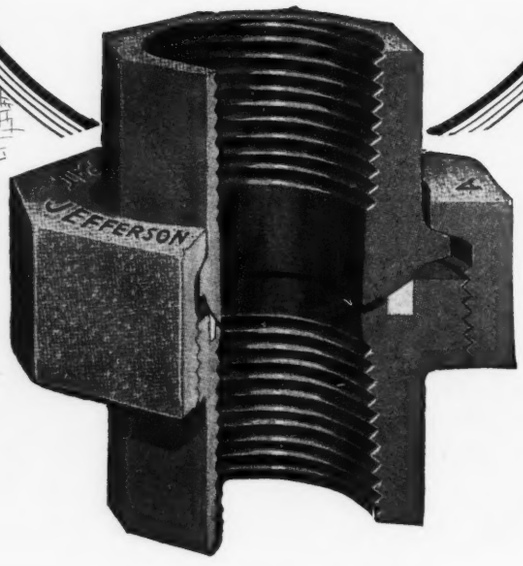
Brass Seat ring located in a recess away from the runway of the fitting (patented feature).

Briggs tapered pipe threads.

Large amount of play in the ball end (an especially valuable feature when pipes are not in line).

Joints ground in pairs (self-seating and absolutely tight).

Style D Flange Union



No. 2 of a series

Clean - Dry - Steam

more than 1,000 installations of

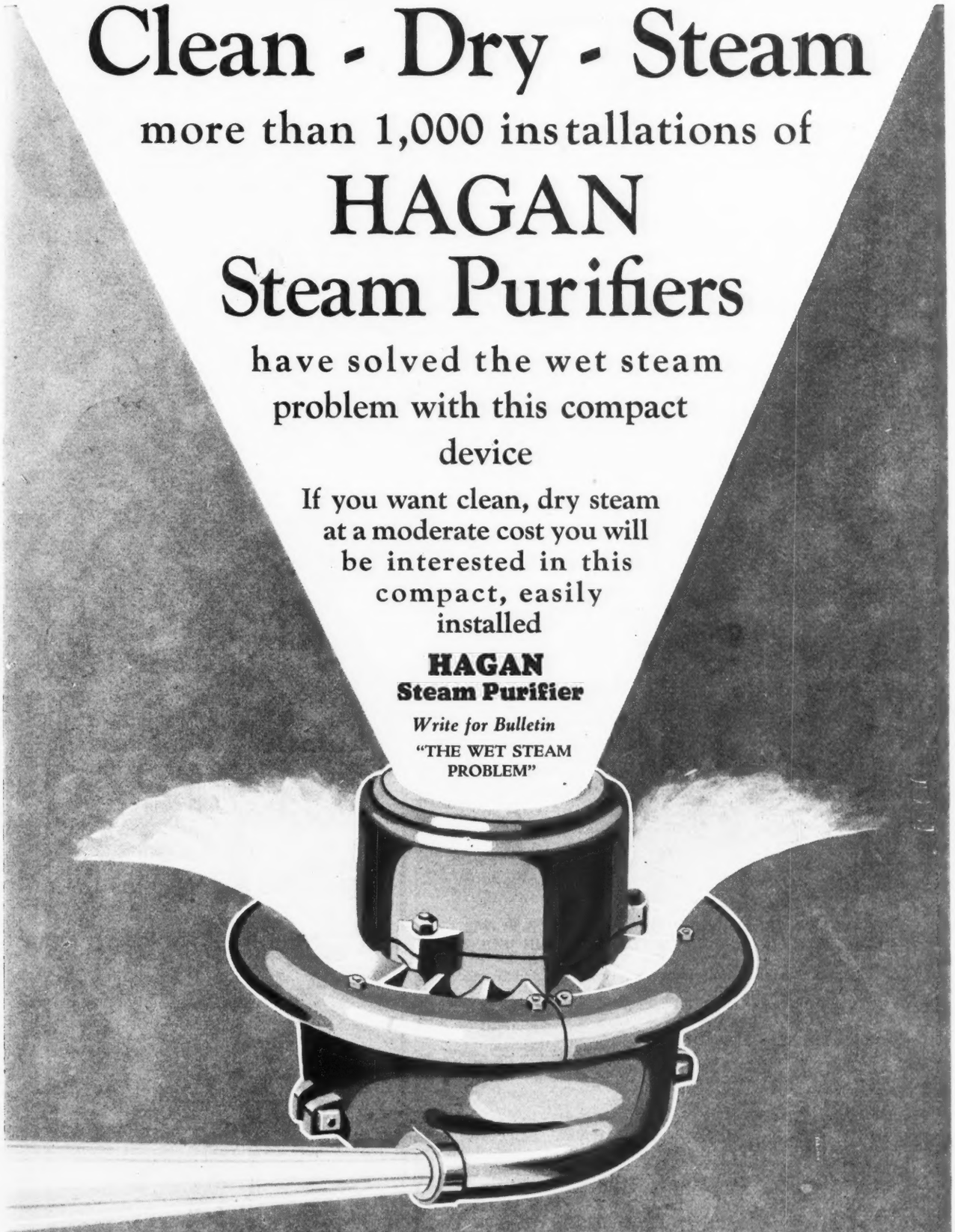
HAGAN Steam Purifiers

have solved the wet steam problem with this compact device

If you want clean, dry steam at a moderate cost you will be interested in this compact, easily installed

HAGAN
Steam Purifier

Write for Bulletin
"THE WET STEAM PROBLEM"



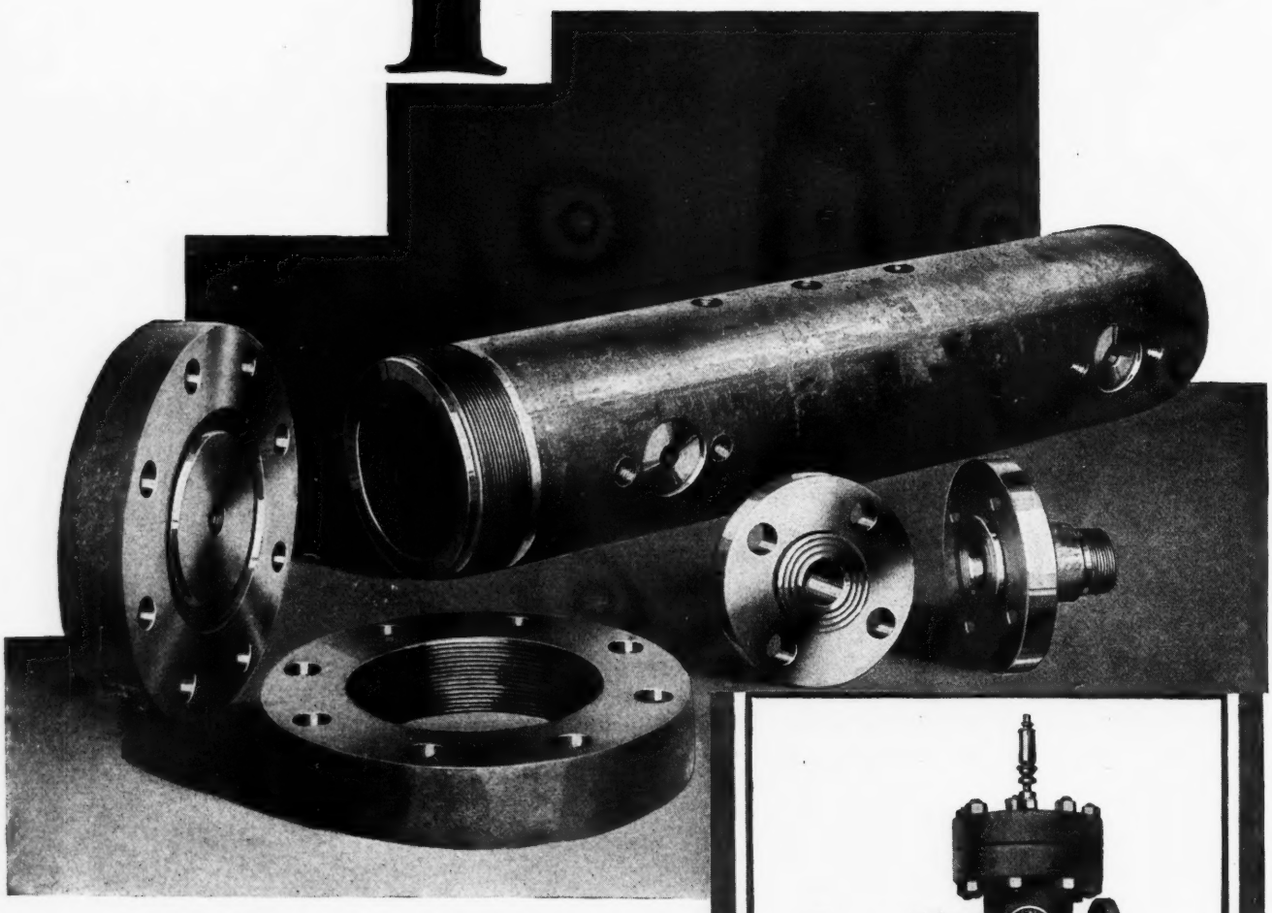
HAGAN CORPORATION

Combustion and Chemical Engineers

502 BOWMAN BUILDING, PITTSBURGH, PENNA.

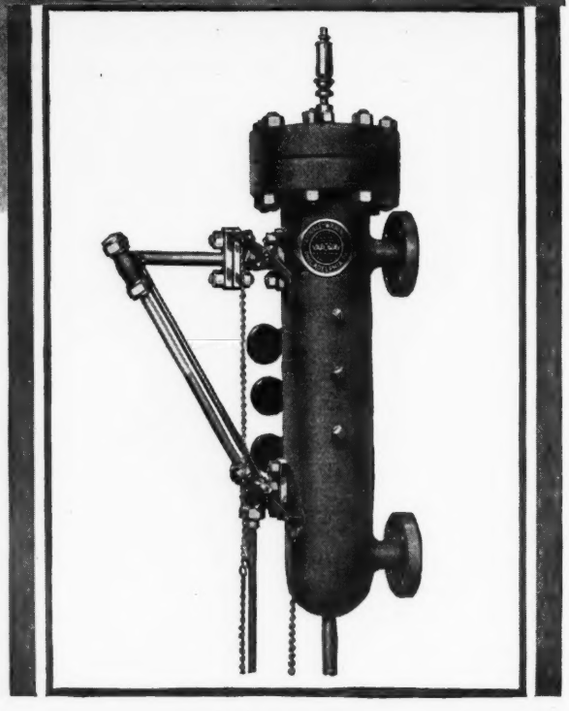
Sales and Service Offices in all principal cities of U. S. A. and foreign countries

FORGED



DISASSEMBLED VIEW OF A YARWAY FLOATLESS HI-LO ALARM WATER COLUMN BODY.

Note that this is not a tube with forged end. It is forged from a solid steel billet.



YARWAY FLOATLESS HI-LO ALARM WATER COLUMN with YARWAY SESURE INCLINED WATER GAGE (Fig. 4110-52). For 400 lbs. working pressure.

YARWAY

STEEL

where Forged Steel is needed!

Forged steel construction for water columns is a natural sequence to the practice of building boiler drums of forged steel for the higher pressures.

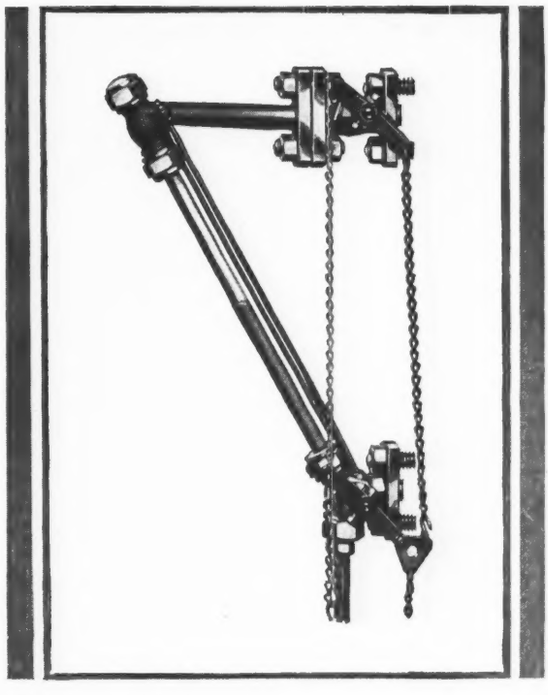
The disassembled view shows the column body of a Yarway Floatless Hi-Lo Alarm Water Column designed for 400 lbs. pressure. All flanges are forged, and the boiler connections are shoulder-threaded and arc welded.

The Yarway Floatless Hi-Lo Alarm Water Column operates on the displacement principle, obviating any possible float trouble. It is provided with a high and low whistle alarm operated by a single valve, and can also be furnished with a light signal alarm if desired. Made for all pressures up to 600 lbs. For the lower pressures it is furnished with a gray iron shell.

The Yarway Se-Sure Inclined Water Gage keeps pace with modern boiler practice by insuring (through the inclined position of the glass) positive visibility of water levels from any angle — even directly beneath. Made in four types for any water gage service up to 600 lbs. pressure. It is standard equipment on the Water Column.

Yarway Water Columns and Gages in all types and for all pressures are illustrated and fully described in Bulletin WC-1801. We will send it promptly at your request.

YARWAY TYPE E SE-SURE INCLINED WATER GAGE, for working pressures up to 400 lbs.



YARNALL-WARING COMPANY
Mermaid Avenue Philadelphia

BOILER DEVICES

Dry 60-cycle flashover of a G-E oil-filled bushing

Steep-wave impulse flashover of a G-E oil-filled bushing

Superior bushings add to G-E transformer reliability

The ability of General Electric oil-filled porcelain bushings to withstand repeated flashovers, under test or in service, and with either normal-frequency potentials or steep-wave impulses has demonstrated their exceptional reliability for all conditions of operation. This reliability accounts, in some measure, for the very successful operation of G-E high-voltage transformers.

For many years, General Electric oil-filled bushings have been in regular use on G-E high-voltage transformers and oil circuit breakers. Their preëminence is shown by tests and by operating records of the many thousands now in service.

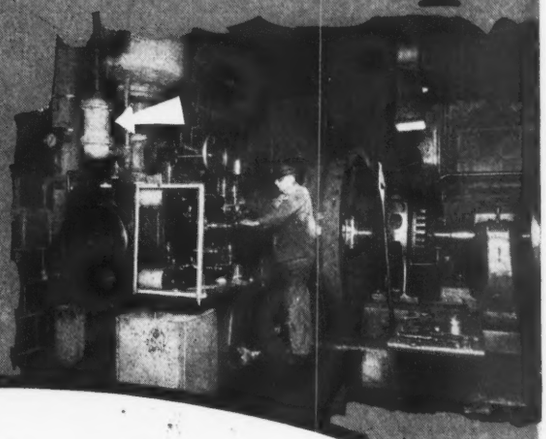
Oil-filled bushings are manufactured complete by General Electric. They are supplied not only for oil-filled apparatus but also for passing high-voltage conductors through walls, floors, and roofs, and are now available for all voltages above 37,000. Every bushing is tested by flashover.

410-13

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

Use Armstrong steam traps WHEREVER steam is used

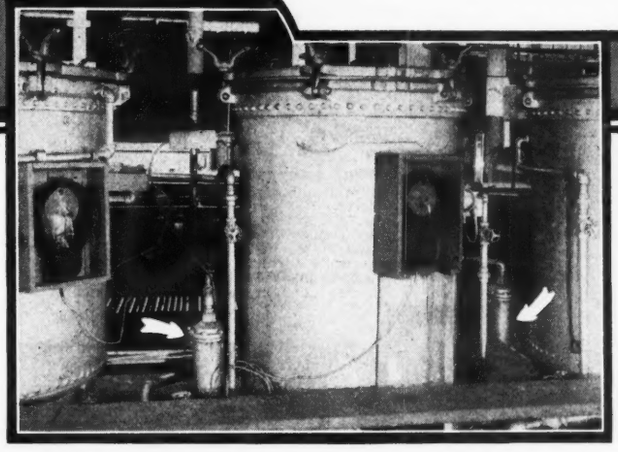


ARMSTRONG TRAPS are saving fuel and guarding steam lines and equipment in thousands of power and industrial plants, railway shops, large office buildings—and wherever steam is used.

Their unique construction gives a small sized trap for a large capacity. That accounts for their low cost. The small size simplifies installation. They fit into any small convenient space and ordinarily require no other support than the pipe line in which they are installed. Air does not affect their operation. They discharge entrapped air with the condensate. The positive operation of the valve—either wide open or tightly closed—and the self-scrubbing feature reduce maintenance to a minimum. They are efficient and economical.

There is a type and size of Armstrong Trap for every draining problem. Send for an Armstrong, and test it 90 days at our expense. It will pay dividends during test period. Then return it if you are not thoroughly satisfied. *Mail the coupon now.*

ARMSTRONG MACHINE WORKS
312 Maple Street, Three Rivers, Mich.
District Representatives in 36 Cities



ARMSTRONG MACHINE WORKS
312 Maple St., Three Rivers, Mich.

Please ship prepaid an Armstrong Trap for a 90-day test. When the test is completed we will return the trap collect.

For service on.....

Size of pipe.....Steam Pressure [Maximum].....

Name and Position.....

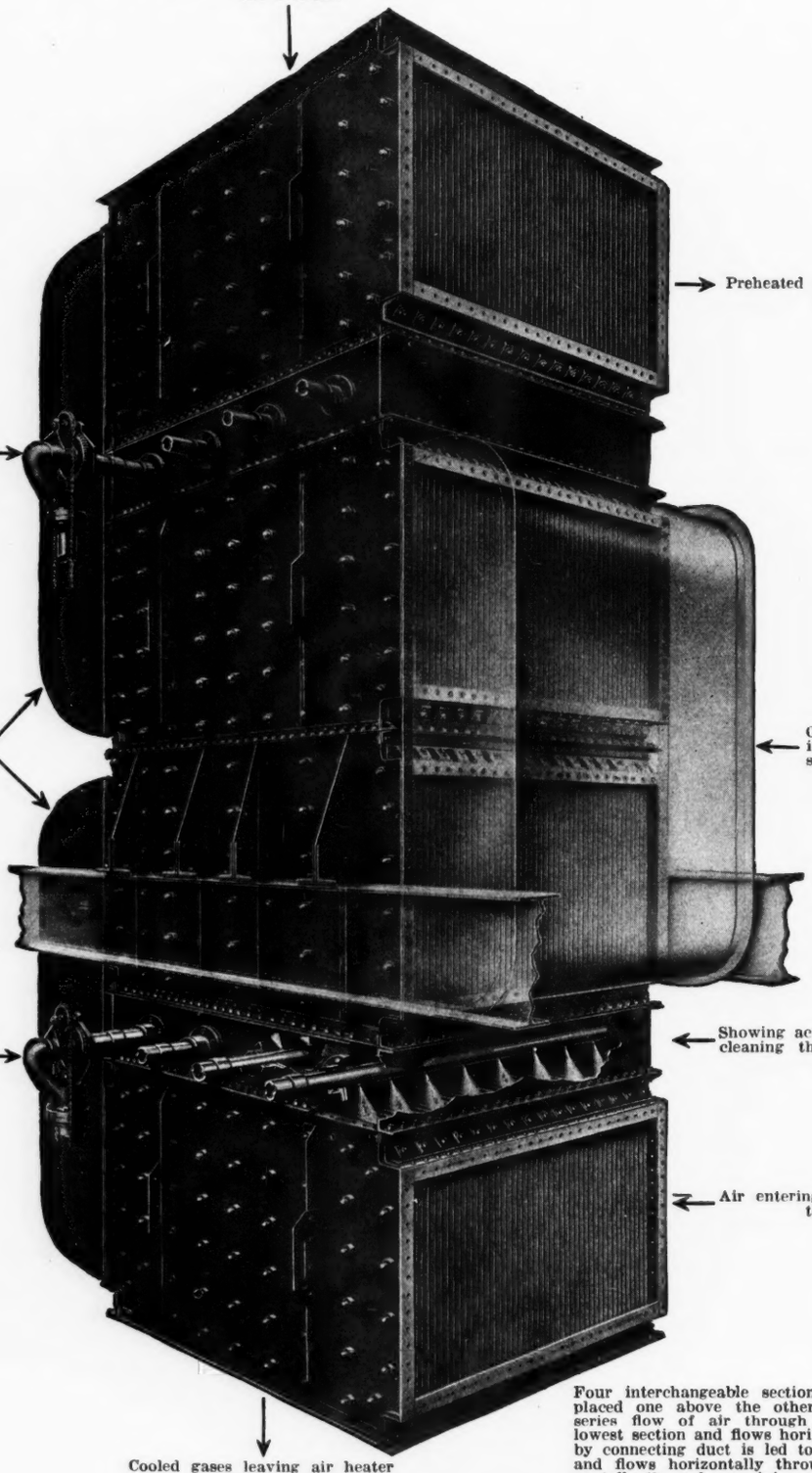
Firm.....

Street Address.....

City and State.....

☐ Send Catalog.

P12-25Gray


Hot gases entering the air heater flow vertically downward through the sections.
Preheated air leaving the Foster air heater.
Sootblower heads provide for positive blowing of each gas space thoroughly; the soot blowers move across the casing to do this.
Connecting ducts, carrying the air leaving one section to the section next above.
Connecting ducts, carrying the air leaving one section to the section next above.
Sootblower heads provide for positive blowing of each gas space thoroughly; the soot blowers move across the casing to do this.
Showing action of soot blowers for cleaning the gas passages in the air heater.
Air entering the lowest section of the air heater.
Cooled gases leaving air heater at bottom.

Four interchangeable sections of Foster air heater placed one above the other and arranged for the series flow of air through them. Air enters the lowest section and flows horizontally through it, then by connecting duct is led to the section next above and flows horizontally through this; likewise horizontally through remaining sections. Each section is interchangeable and is fabricated complete at the shops before shipment.

AERO UNIT COAL PULVERIZERS
AIR HEATERS CENTRIFUGAL PUMPS
CONDENSERS COOLING TOWERS
ECONOMIZERS EVAPORATORS
EXPANSION JOINTS FEED WATER HEATERS

FOSTER

Foster Sectional Air Heaters

(Haber Patents)

Four interchangeable sections of a Foster air heater, arranged one above the other, and connected for the series flow of air, are shown in the accompanying illustration.

Gases pass vertically downward through the sections. Air enters the lowest section and passes horizontally through it, absorbing heat from the gases flowing on opposite sides of the steel sheets which comprise the sections. The air then passes into a connecting duct leading to the next section above and flows horizontally through this second section, absorbing additional heat from the gases. In like manner, the air passes from each section to the one above, flowing at all times across the path of the gases and counter-current to them. This quadruple counter- and cross-flow assures an efficient heat transfer for the unit.

The Foster air heaters being installed at the Philo station of the Ohio Power Company each consist of 16 interchangeable sections, arranged in groups four sections high, as illustrated. Four such groups are placed parallel to each other to make up a complete heater and contain 51,000 sq.ft. of heating surface. They are designed with the capacity to preheat more than 310,000 lb. of air per hour from 100 deg. F. to a temperature of 519 deg. F.

FOSTER WHEELER CORPORATION

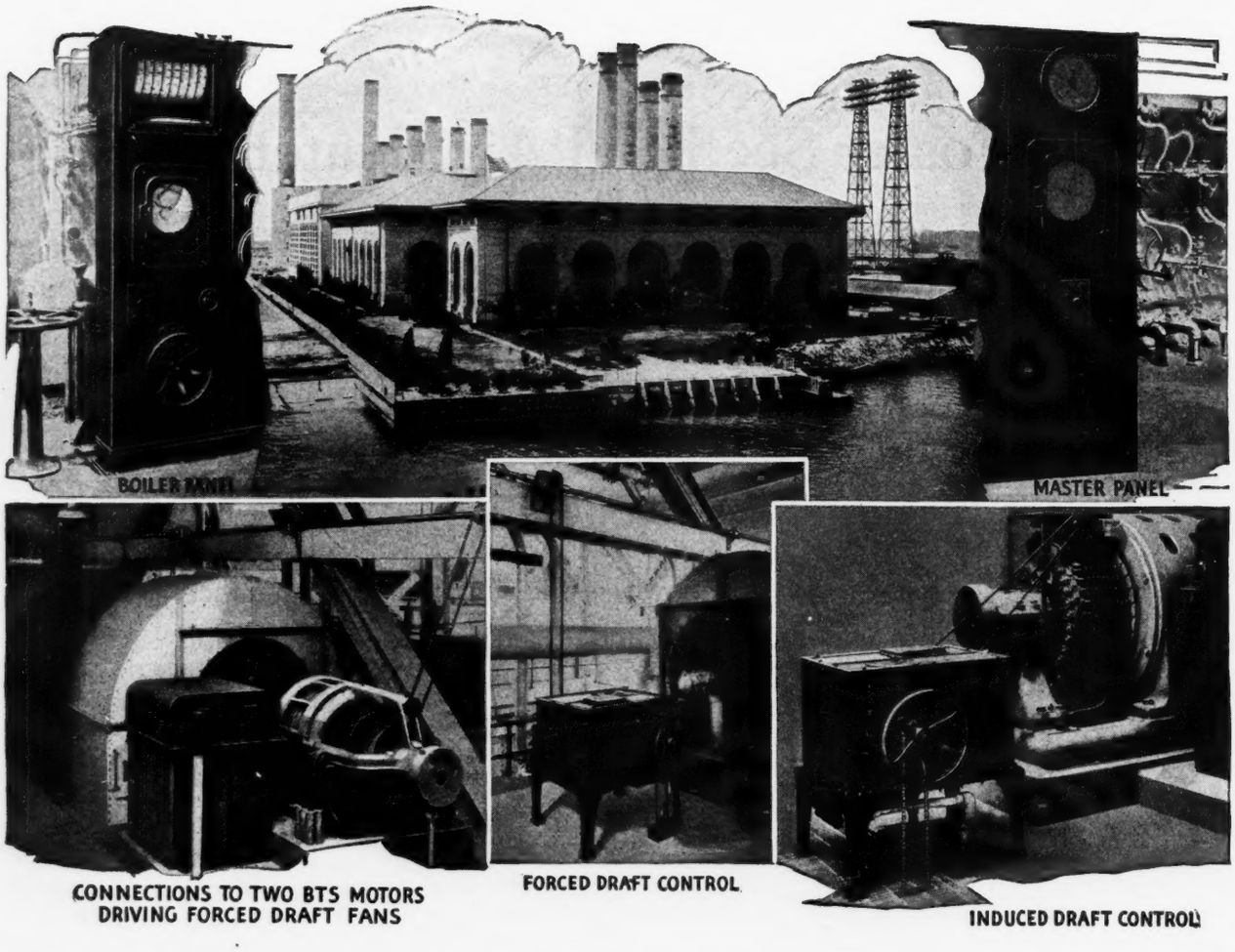
165 Broadway, New York, N. Y.

Branches in Principal Cities

Foreign Associates—
Foster Wheeler Limited: London, England.
Foster Wheeler Limited: Toronto-Montreal-Vancouver, Canada

WHEELER

FRACTIONATING TOWERS HEAT EXCHANGERS
STEAM JET AIR PUMPS SUPERHEATERS
TUBE STILLS VACUUM PUMPS
WATER COOLED FURNACE SURFACES
BRASS AND COPPER TUBING AND PIPE



Bailey Meter Control

at Long Beach

The third section of Long Beach Station of the Southern California Edison Company, containing three 3416 hp. boilers, is now operating under complete Automatic Bailey Meter Control.

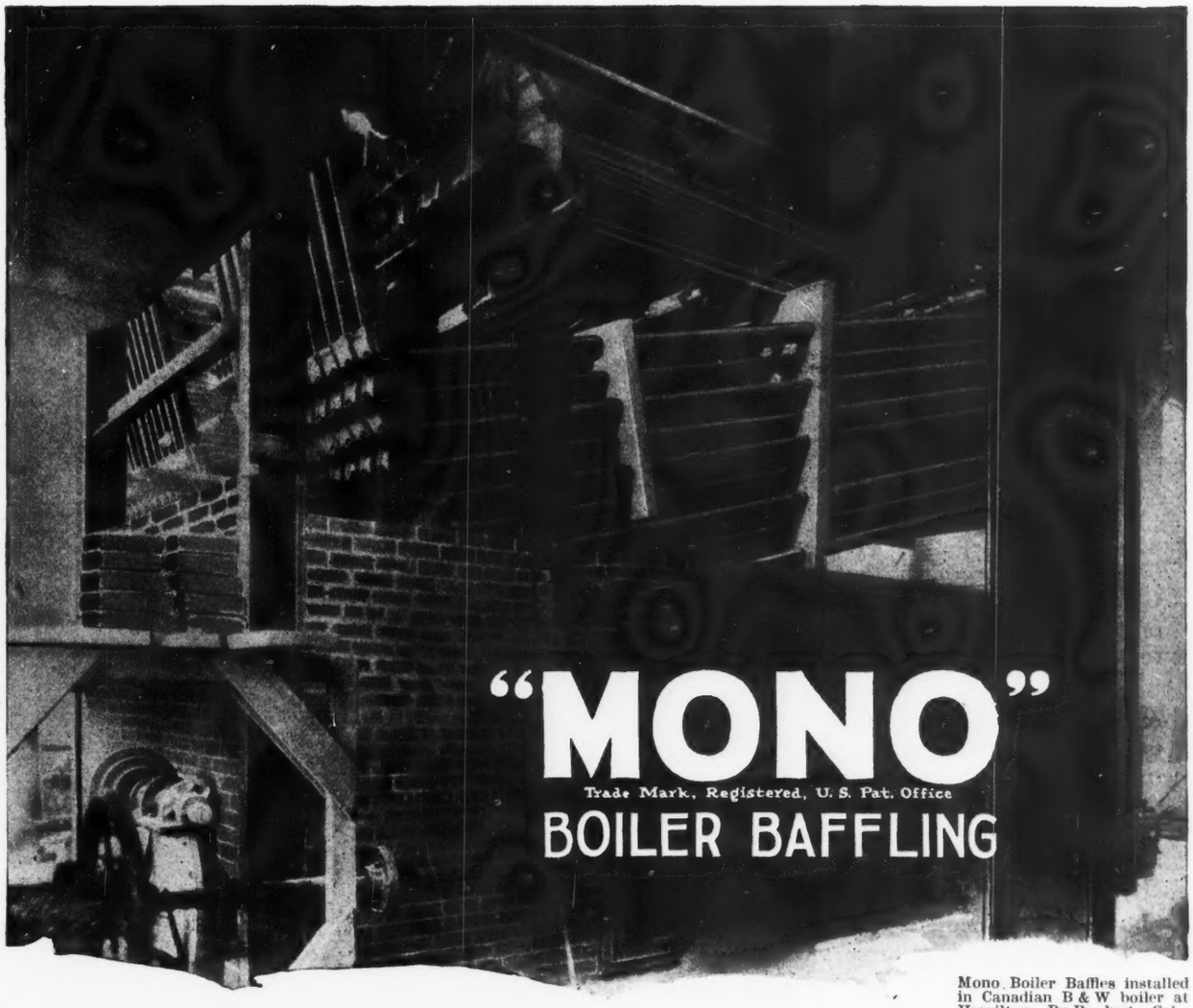
Bailey Meter Control provides for the complete automatic control of one or a number of boilers. It regulates the quantity of fuel and air admitted to the furnaces of all boilers so as to satisfy the steam requirements as indicated by changes in the steam pressure. The air supply to each individual boiler is readjusted automatically to maintain the proper relation between the quantities of fuel and air to give best combustion efficiency. The forced draft is readjusted automatically to maintain a balanced draft, or a furnace draft which may vary slightly with boiler rating, if desired. All changes in steam pressure are therefore quickly corrected, and maximum economy is maintained at all times.

Bailey Meter Control is applicable to all types of boilers, and to stoker, pulverized coal, gas or oil firing. Every proposed installation is preceded by a comprehensive engineering survey of all operating factors.

Write for Bulletins 43 and 162

BAILEY METER COMPANY

1036 IVANHOE RD. CLEVELAND, OHIO



Mono Boiler Baffles installed in Canadian B & W boiler at Hamilton By-Product Coke Co., Hamilton, Ont., proportioned for burning coke braize.

Adds capacity—to the boiler

More steam from your existing boilers, with improved combustion and lower maintenance of refractories—are sound reasons why you should install "MONO" Boiler Baffling.

The flexible monolithic construction expands and contracts under temperature changes without cracking or spalling. It seals every tube gas tight when hot—yet shrinks away sufficiently when cold to allow any tube to be removed and replaced without injury to the baffle construction.

Unsurpassed in mechanical strength—and able to resist shock and vibration due to turbine cleaners, without injury.

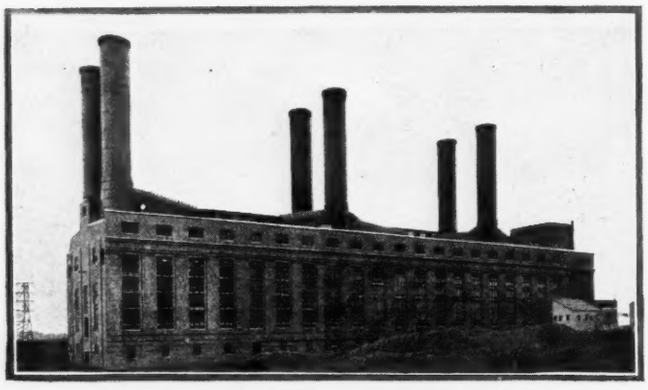
"MONO" oiler Baffling is designed by experienced furnace engineers. Consultation regarding its application to your boilers is invited.

For long lasting furnace construction use "Flame Brand" High Temperature and Insulating Cements. Instruction Booklet sent free on request.

King Refractories Co., Inc.

Main Office and Works:

1709-1715 Niagara St., Buffalo, N. Y.



Charles R. Huntley Station, Showing 1928 Extension.

New
Pulverized-Coal Fired
Boilers
at
"Buffalo"

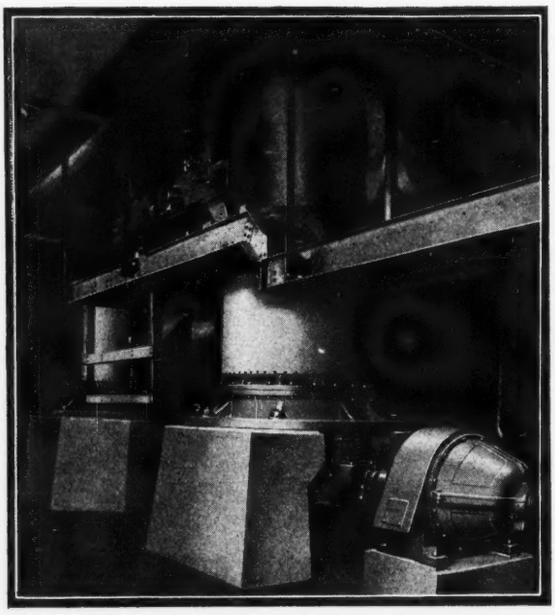
First unit placed in service met three-hour emergency demand for 200,000 lb. of steam per hour (493% of rating) when lighted for first time

The first boiler of the new extension of the Charles R. Huntley Station of the Buffalo General Electric Company, Buffalo, N. Y., was fired for the first time on September 25, 1928.

In 35 minutes it was on the line carrying an emergency demand for 200,000 pounds of steam per hour (493 per cent of rating). This it continued to do for three hours. On the following day the unit carried the same load for 7½ hours. Since then it has been regularly used to help meet the varying load demands upon this station.

The fact that it was possible to put this unit into service immediately after being first lighted and to keep it in regular service is evidence of the engineering skill and care that attended its manufacture and erection.

The unit is one of four Babcock & Wilcox boilers, each of 13,810 sq. ft. of heating surface, that are being installed in this station, which is part of the Buffalo, Niagara and Eastern Power Corporation's hydro-electric system. The steam plant is used for emergency stand-by service and to carry the base load when system conditions demand. Each boiler unit has a complete Fuller Lehigh, Bailey Water-Cooled Furnace of the slag-tap type and is pulverized-coal fired by the Fuller Lehigh Direct-Fired System.



Fuller Lehigh Pulverizing Mills and Raw-Coal Feeders in 1928 Extension of Charles R. Huntley Station of the Buffalo General Electric Company. Total capacity of the four new units will be 1,200,000 lb. of steam per hr.

Liquid-ash removal which proved so successful in the initial Fuller Lehigh Equipped installation is a feature of this new extension.

For further information on this extension and on the initial installation, write us

for reprints, articles and other information relative to the Chas. R. Huntley Station.

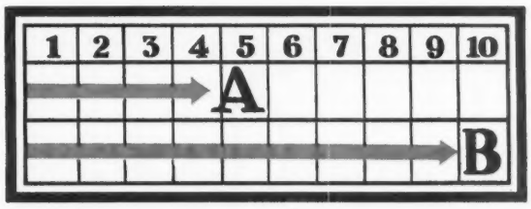
1-70

FULLER LEHIGH COMPANY, FULLERTON, PENNA.~*A Babcock & Wilcox Organization*

FULLER LEHIGH

PULVERIZED-COAL EQUIPMENT ~ WATER-COOLED FURNACE WALLS

RAMTITE
lasts
two to three times as long...

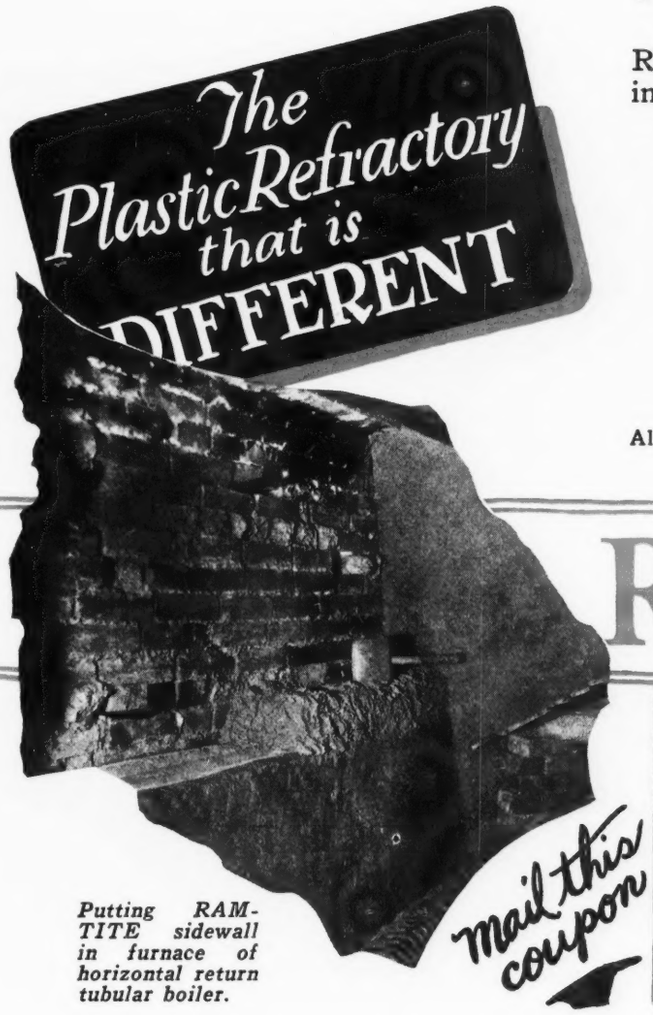


The line A represents the life of a fire brick lining whereas B is RAMTITE used under the same conditions in the same service.

BEING a plastic monolithic furnace lining all joints are eliminated and with them the greatest cause of furnace lining failure. Disintegration of fire brick usually starts at the joints. RAMTITE has no joints, and wherever it has displaced fire brick the life of the furnace lining has been increased two to three times. The use of high quality virgin refractories and a special mulling process in the manufacture of RAMTITE give it unusual heat and erosion resisting qualities which minimize the necessity of repairs between relining periods.

It will pay you to learn all about RAMTITE, the monolithic furnace lining which is different.

SEND THE COUPON TODAY.



Putting RAMTITE sidewall in furnace of horizontal return tubular boiler.

The S. Obermayer Company
2563 W. 18th Street, Chicago, Illinois

Canadian Distributors:
Riley Engineering & Supply Co., Ltd.
360 Dufferin Street, Toronto 3, Canada

Manufacturing Plants:
Chicago, Cincinnati, Pittsburgh, Springfield, Mass.
Carried in stock in 26 cities

Also manufacturers of HOTT-PATCH and other high temperature cements.

RAMTITE

mail this coupon

Please send us a copy of the booklet on RAMTITE.

Name.....

Company.....

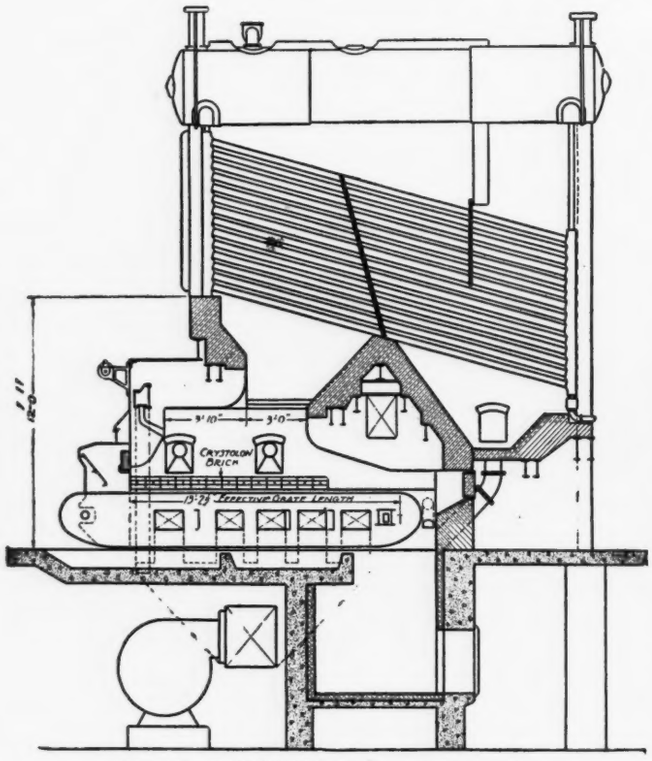
City.....

State.....

P12-25-Russell T. Gray, Inc.

Equally as Efficient with Coke Breeze

Harrington Traveling Grate Stoker



Two 7′ x 13′-2½″ Harrington Stokers under
two 400 H.P. B. & W. Boilers
Holyoke Gas & Electric Co., Holyoke, Mass.

Gas Companies and The Harrington Traveling Grate Stoker

Gas Companies are realizing how efficiently the Harrington Stoker performs when burning gas house coke. In Massachusetts alone the Holyoke Gas and Electric Co., The Fitchburg Gas Co., and the Brockton Gas Co. have recently ordered Harrington Stokers. Below are a few of the many gas companies using Harrington Stokers.

Consolidated Gas Co., Long Branch & New York
Luzerne Gas & Electric Co., Hunlock Creek
Philadelphia Suburban Gas & Electric Co.,
Phoenixville, Chester, Oreland
Western United Gas & Electric Co., Aurora
Consolidated Gas Co., Baltimore
Washington Gas Light Co., Washington
Wilmington Gas Co., Wilmington
Public Service Electric & Gas Co., Harrison
Equitable Gas Co., Elramo
Detroit City Gas Co., Detroit
Grand Rapids Gas Light Co., Grand Rapids
Penn Gas Co., Warren
Indiana Coke and Gas Co., Terre Haute
Denver Gas & Electric Co., Denver
N. Y. State Gas & Electric Co., Ithaca

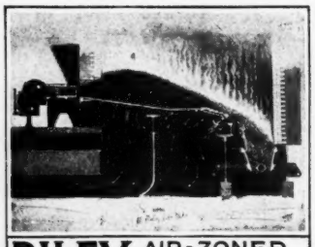
The Harrington—*An Extremely Flexible Stoker*

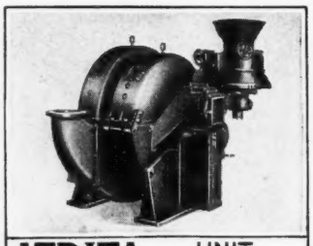
The gas companies which have installed the Harrington Stokers not only have the advantage of the outstanding stoker for burning coke breeze but also for burning a wide range of fuels. For instance, unthought of efficiencies are being obtained today with the Harrington burning anthracite and Dakota Lignites. It is equally efficient with bituminous coals, Ohio, Indiana, Illinois, and Iowa coals, other forms of coke breeze and river coal. The Harrington has the greatest flexibility both as to load range and types of fuels. It will pay you to learn more about it. ***Write us.***

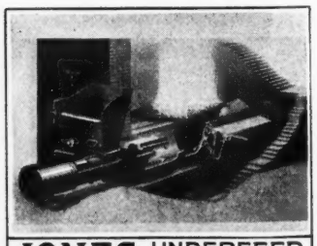
RILEY STOKER CORPORATION

9 Neponset Street, WORCESTER, MASS., U. S. A.
Riley Engineering & Supply Co., Ltd., Toronto, Canada

HARRINGTON TRAVELING GRATE STOKERS


RILEY AIR-ZONED SUPER-STOKER

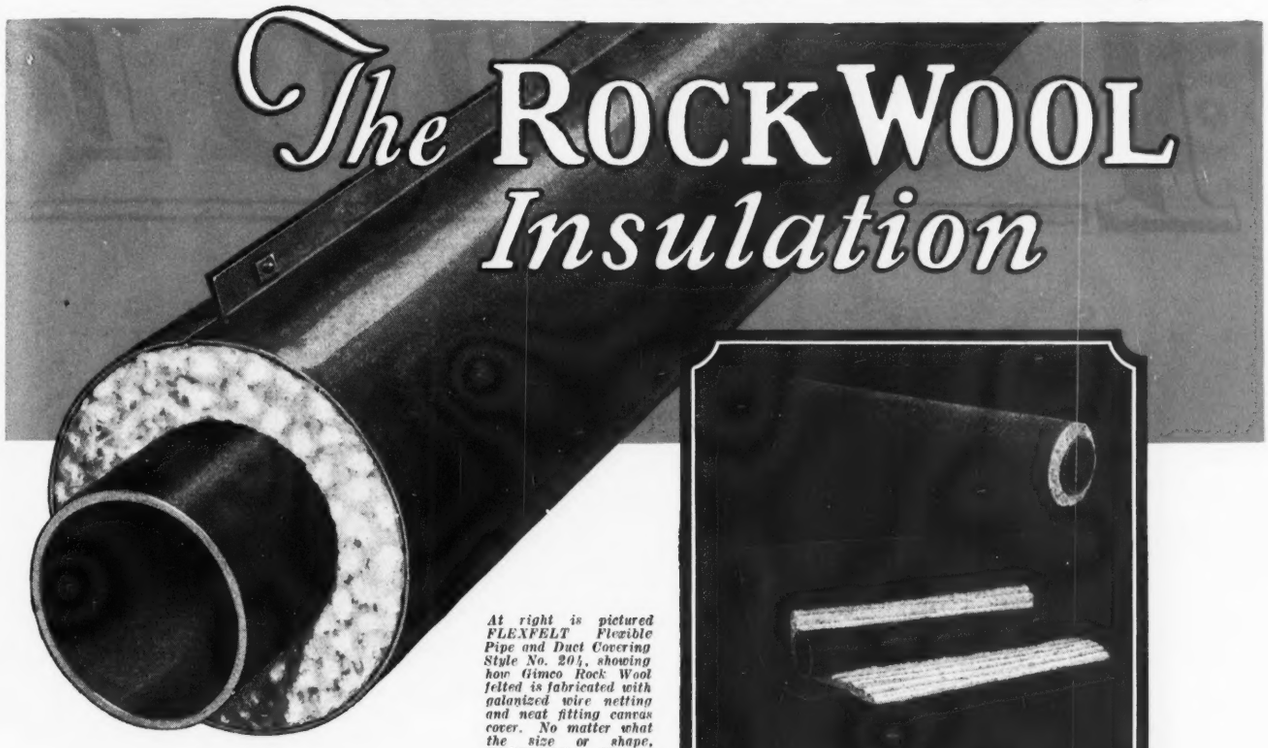

ATRITA UNIT PULVERIZER


JONES UNDERFEED STOKERS

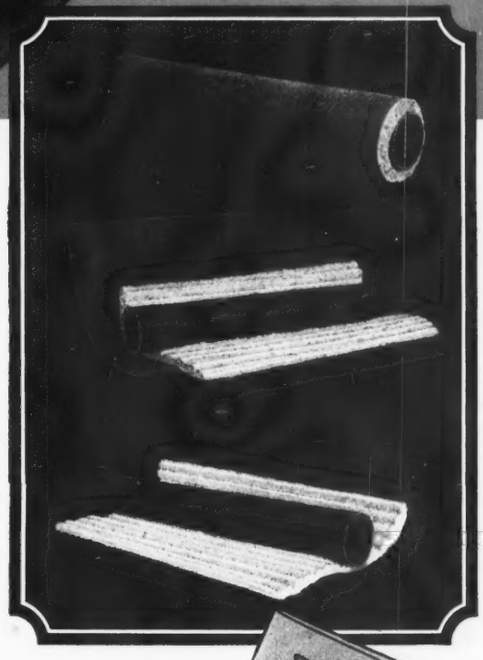
Gimco
ROCK WOOL

FLEXFELT

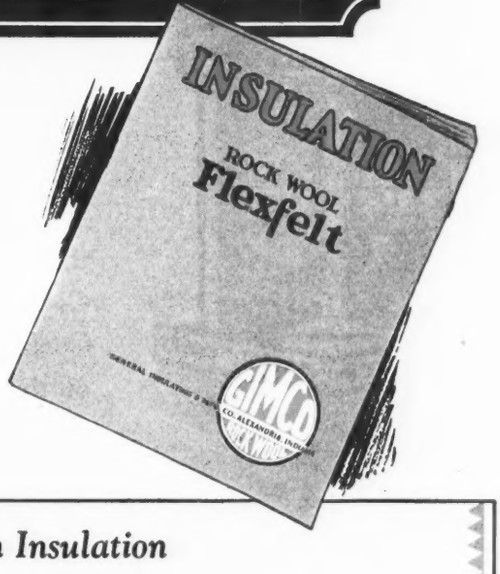
The ROCK WOOL Insulation



At right is pictured FLEXFELT Flexible Pipe and Duct Covering Style No. 20½, showing how Gimco Rock Wool felted is fabricated with galanized wire netting and neat fitting canvas cover. No matter what the size or shape, FLEXFELT Flexible Pipe Covering is easiest to apply and most efficient to use.



THE above picture shows the metal-cased pipe insulation with the interlocking joint, which is establishing new standards of efficiency and economy in the refinery field. Fire-proof, water-proof—easily installed and quickly removable! It is **FLEXFELT** Style No. 206 (patent applied for)—the finest Rock Wool felted and encased in weather-defying 24-gauge galvanized iron. Just slip over pipe and tighten bolts. Each handy 24-inch length interlocks with another in such a manner that a uniform density of Rock Wool is maintained at all joints *without any plastering.* Remember, too, that you can always salvage **FLEXFELT** No. 206 when you make changes in equipment. Remove from old equipment; replace on new with every assurance of the same high efficiency. Get all the facts—and prices—at once. Use the coupon below.



Gimco Rock Wool is available in these forms:

(1) Flexfelt—Standard Shapes or cut to fit;
(2) K-14 Insulating Cement;
(3) Insulating Block and Brick;
(4) Rock Wool Cork for Cold Storage Insulation.

General Insulating and Manufacturing Co.
Alexandria, Ind.

Tulsa Representative:
Rock Wool Insulation Co., P. O. Box 286, Tulsa, Okla.

Send Me Your New Book On Insulation

NAME_____ COMPANY_____ ADDRESS_____

2 BOILERS, REBUILT I
DO WORK OF 3 -

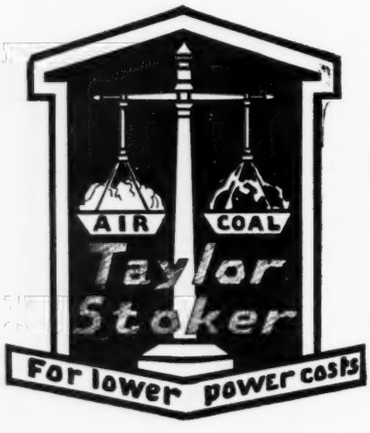
Taylor

The Problem

THE Atmospheric Nitrogen Corporation, Syracuse, N. Y., faced the problem of doubling the capacity of its boiler plant while maintaining 24-hour steam supply constinuously.

It solved this problem, saved the cost of a new $50,000 boiler and at the same time attained greater fuel economy by removing old type stokers from beneath two 5,020 sq.-ft. Stirling boilers, set in battery, and installing longer Taylor Stokers of modern type.

Speed was essential in performing this work, since it was necessary for a single boiler to carry the entire load while the other was closed down.

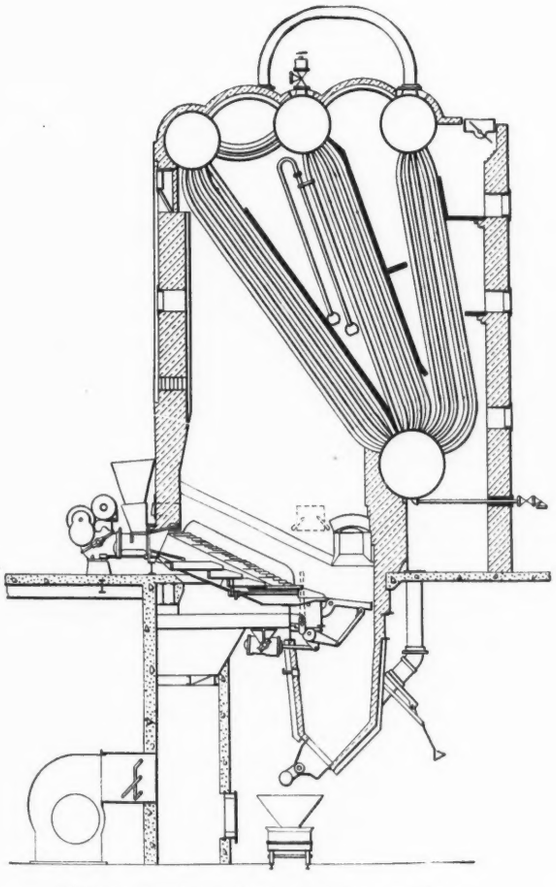


It is believed that a record for such a job was set when the first of the new stokers was installed in seven days and the second in six days.

Improvements in capacity and economy resulting from these changes, as summarized by W. R. McCann, Chief Construction Engineer of the Atmospheric Nitrogen Corporation, in a recent issue of POWER, are detailed on the opposite page.

Send for your copy of "Development and Recent Design of Stoker-fired Equipment for Steam Generation." No engineer's library is complete without it.

IN RECORD TIME, $50,000 SAVED with Stoker



Modern Taylor Stoker Installation at plant of Atmospheric Nitrogen Corporation, Syracuse, N. Y.

The Results

THE boiler rating increased from 127 per cent to 250 per cent on 13,500 B.t.u. coal.

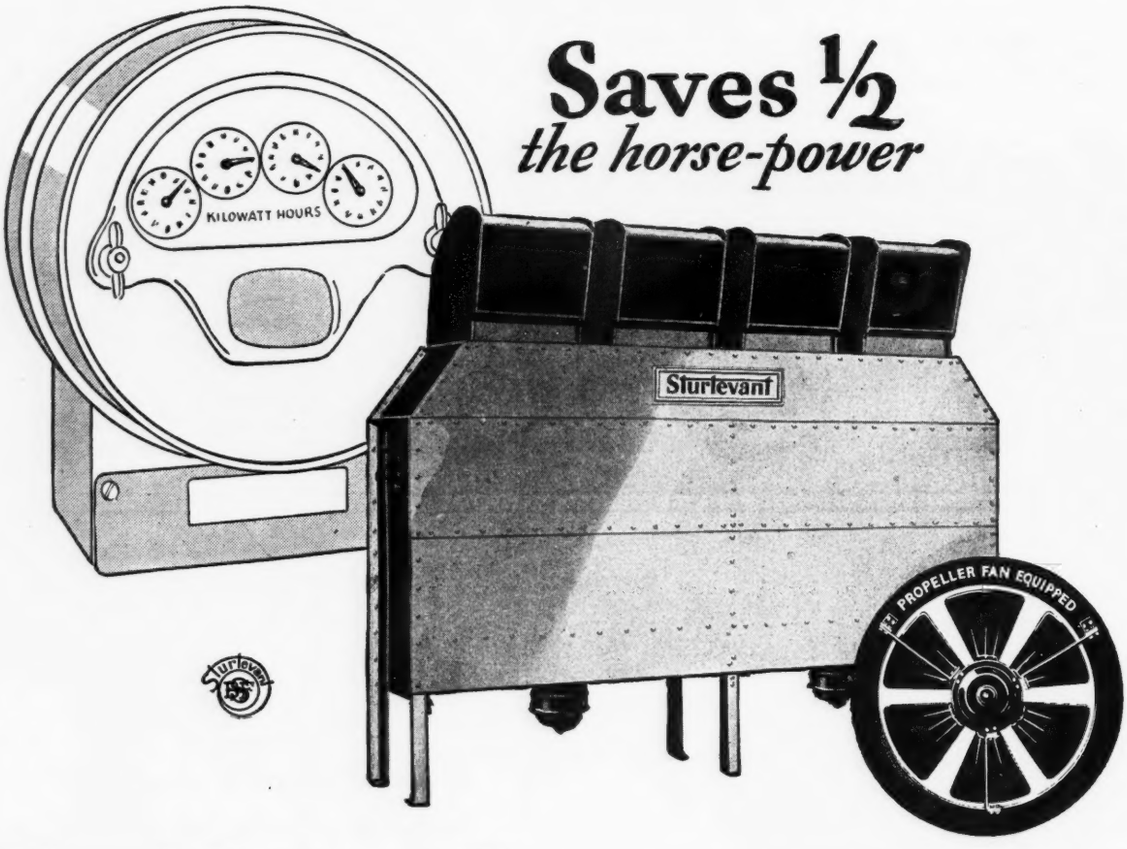
The equivalent increase of capacity was equal to a third boiler of an estimated cost of $50,000.

The increased economy of the new stokers, compared to the old type, was 8 per cent.

AMERICAN ENGINEERING COMPANY

2402 Aramingo Avenue Philadelphia, Pa.

In Canada, Affiliated Engineering Companies, Ltd., Southam Bldg., Montreal, Que.



Saves ½ *the horse-power*

"The Meter will prove our point!"

The "Tempervane" requires 50% less current than units equipped with centrifugal type fans!

LET a Sturtevant Engineer explain how the "Tempervane" effects this economy in industrial heating—

"The 'Tempervane' Unit Heater utilizes Aerofin heating elements. These elements offer a very low resistance to air. Propeller fans operate at their highest efficiency against low resistances, whereas centrifugal fans operate at lowest efficiency against low resistances.

"The issue was plain and clean cut. We chose propeller fans, cut motor horsepower fifty per cent and halved the current consumption. Exhaustive laboratory and service tests have proved we were right—and the meter will prove our point!"

Suspended type "Tempervane"

Precedent played no part in the design of the "Tempervane". It would have been just as easy to have specified centrifugal fans (of which, Sturtevant manufactures thousands), but our Engineers were out to design a better unit heater . . . better in performance . . . most economical in current consumption.

The "Tempervane" is the result. It has been subjected to the most exacting laboratory and service tests ever conducted . . . It has proved itself by meeting the highest standard ever established for industrial heating equipment.

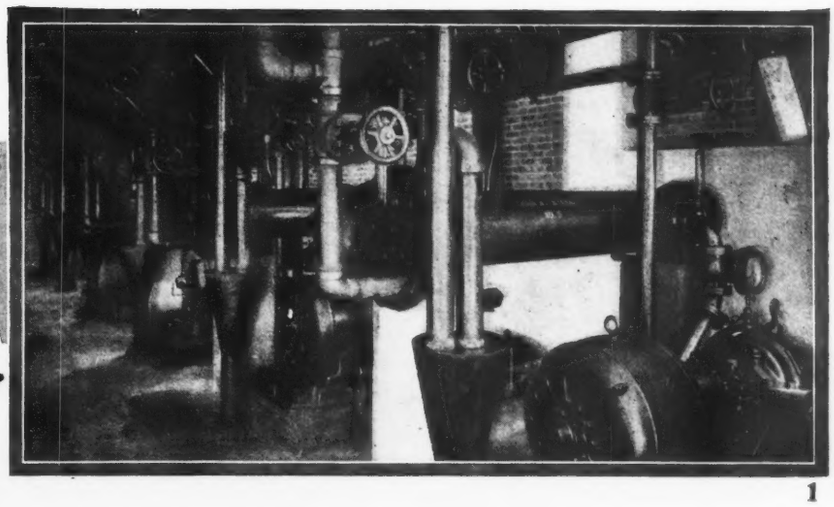
We would welcome your request for indisputable evidence of "Tempervane" economy. Write our nearest office for Catalog 363.

B. F. STURTEVANT COMPANY

Plants and Offices at: Berkeley, Cal.—Camden, N. J.—Framingham, Mass.—Galt, Ontario—Hyde Park, Mass.—Sturtevant, Wis.

Branch Offices at: Atlanta; Birmingham; Boston; Buffalo; Camden; Charlotte; Chicago; Cincinnati; Cleveland; Dallas; Denver; Detroit; Hartford; Indianapolis; Kansas City; Los Angeles; Milwaukee; Minneapolis; New York; Omaha; Pittsburgh; Portland; Rochester; St. Louis; San Francisco; Seattle; Washington, D. C.; *Canadian Offices at:* Toronto, Montreal and Galt.
Also Agents in Principal Foreign Countries.

Sturtevant REG. U.S. PAT. OFF. *Tempervane* **Heating Units**



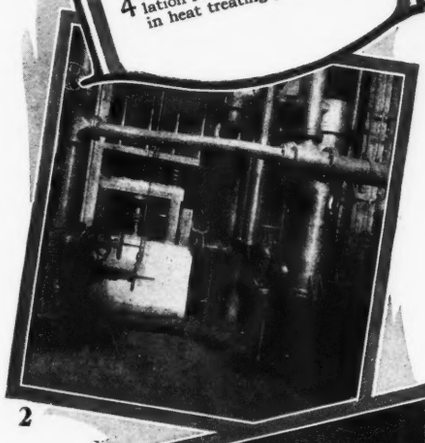
1

1 Multiwhirl Oil Coolers on transformer oil cooling service in a large central power station.

2 Multiwhirl Oil Cooler installation for cooling the oil to turbine bearings.

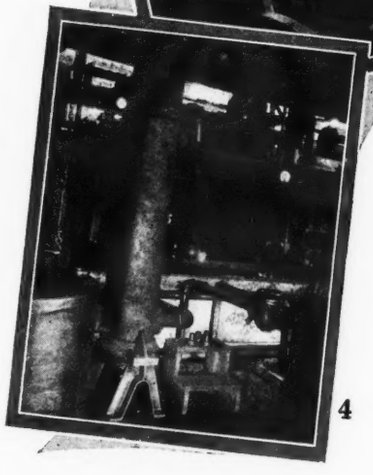
3 Multiwhirl Oil Cooler installation for cooling oil from bearings of Diesel engine.

4 Multiwhirl Oil Cooler installation for cooling quenching oil in heat treating processes.



2

3



4

The Multiwhirl Cooler
—for every oil-cooling operation

BEARING lubricating oil, transformer oil and quenching oil must be kept at proper temperatures for trouble-free, economical service. By installing a G-R Multiwhirl Oil Cooler, the heat imparted to these oils is quickly and efficiently removed, permitting the oil to be used over and over again without danger of overheating or impairment of quality.

Thousands of highly successful installations have established for the G-R Multiwhirl Oil Cooler a reputation for effective and dependable operation on oil cooling service. Besides serving as a safeguard for trouble-free operation of important equipment, a G-R Multiwhirl Oil Cooler installation also assists plant economy by greatly reducing the frequency of oil renewals.

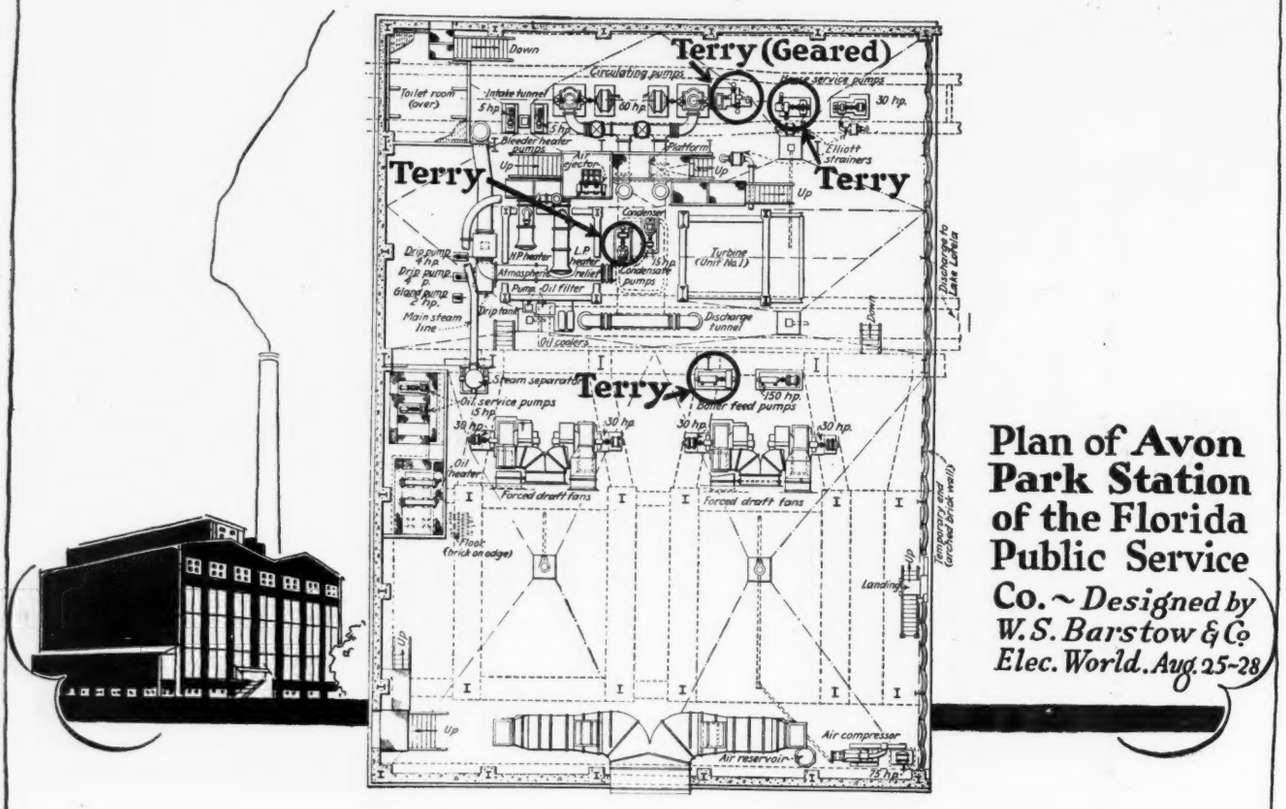
The Griscom-Russell Co., 285 Madison Ave., New York

Philadelphia	Chicago		St. Louis	San Francisco
Boston	Cleveland		Kansas City	Los Angeles
Rochester	Indianapolis		New Orleans	Seattle
Pittsburgh	Detroit		Houston	Denver
Massillon	Memphis		Atlanta	Tulsa
Columbus	Milwaukee		Charlotte	Dallas
	Minneapolis			

For Canada: Riley Engineering & Supply Co., Ltd., Toronto

Griscom-Russell
Heat Transfer Apparatus

All the Auxiliary Turbines at AVON PARK are TERRYS ~



Plan of Avon Park Station of the Florida Public Service Co. ~ *Designed by W. S. Barstow & Co. Elec. World. Aug. 25-28*

One of the most remarkable features of this new 15,000 kilowatt central station of the Florida Public Service Company is the fact that it can be actually operated by one man.

To make it possible for one man to handle the entire station, simplicity and reliability were made the key-notes in the design.

Dependable Terrys were, therefore, the logical choice for the auxiliary turbine drives.

The Terry Steam Turbine Company

TERRY SQUARE, HARTFORD, CT.
OFFICES IN PRINCIPAL CITIES
Steam Turbines + Gears + Shaft Couplings

T-1026

Cracked steam chest—a repair where SMOOTH-ON saved much money

THIS crack in the edge of a high-pressure steam chest opened up many unwelcome possibilities. The price of a new chest was in itself a heavy item; the cost of dismantling and reassembling was also a big consideration; and worst of all, no long service interruption could be tolerated.

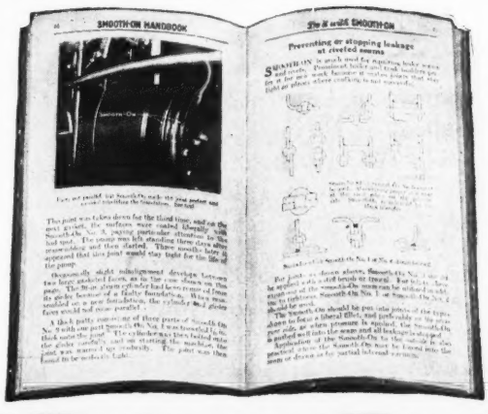
The crack was therefore cleaned out, pounded full of SMOOTH-ON No. 1 and more under an angle patch plate was forced tightly over the crack by drawing up the patch-plate bolts. As a further reinforcement, the two heavy straps were put around the chest and tightened.

This SMOOTH-ON repair has proven permanent, and at very small cost has enabled the engine to do everything that it would before the crack appeared.

Other practical repairs to stop leakage at cracks and gaskets of pressure cylinders—big and little—are fully explained in the SMOOTH-ON Handbook. Get your copy, read it carefully, and you will be well posted on emergency repairs that you may have to face any day.

The SMOOTH-ON HANDBOOK FREE if you return the coupon

Twentieth Edition — 136 pages of data — 193 diagrams, pictures and practical hints on at least 200 different uses for SMOOTH-ON. Every progressive engineer should have this book—get your copy NOW.



Get your SMOOTH-ON *No. 1 in 1 or 5-lb. can or 25, 50 or 100-lb. keg, from your nearest dealer or if necessary from us direct.*

SMOOTH-ON MFG. CO.
Dept. 30, 570 Communipaw Ave., Jersey City, N. J.
Please send copy of the SMOOTH-ON HANDBOOK, 20th Edition.

Name .....

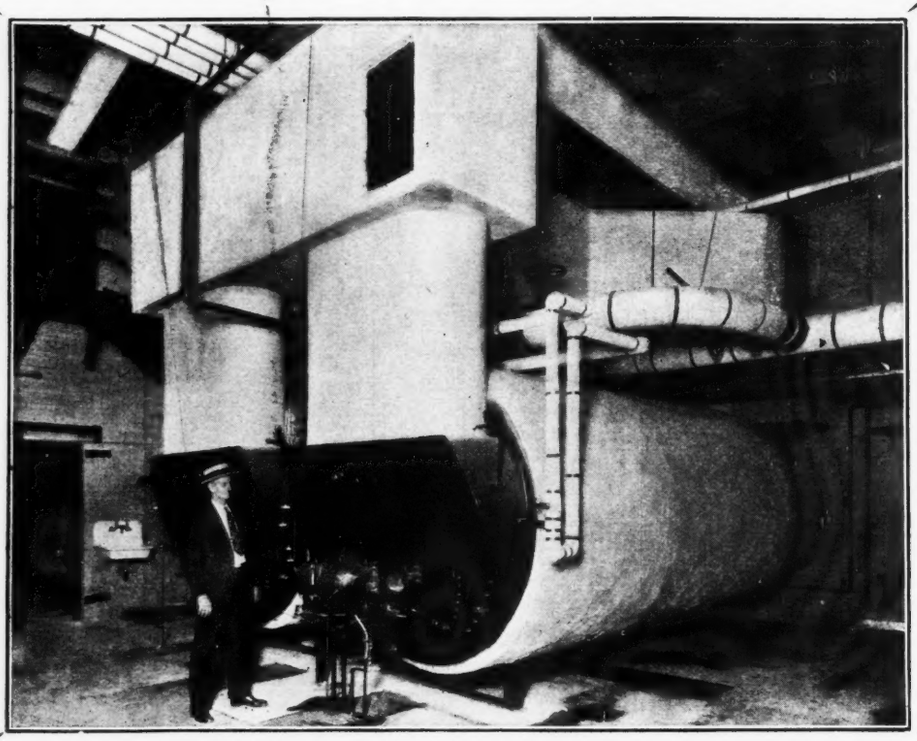
Address .....

.....

12-25-28

SMOOTH-ON

"From Mine to Finished Product"



Boiler Room of Federal Reserve Bank, Baltimore, Md. (Charles L. Reider, Mech. Eng.) showing boilers and breeching insulated with K & M 85% "Featherweight" Magnesia Blocks 2 in. thick, hard-finished with ½ in. thickness of K & M Velvet Hard Finish Cement. Piping insulated with K & M 85% "Featherweight" Magnesia, Standard Thick.

BUY LIGHTNESS, NOT DEAD WEIGHT

It's the air cells in carbonate of magnesia that makes it such ideal insulation. The asbestos fibre merely provides the necessary structural strength.

K&M 85% Featherweight Magnesia is much lighter than other coverings. It contains a high percentage of carbonate of magnesia and its long-fibre asbestos, carefully carded, gives it strength equal to denser materials.

Both low-pressure and high-pressure boilers and steam lines need this protection. Above is an installation in the Federal Reserve Bank in Baltimore showing how to insure a low-pressure boiler against loss of efficiency.

Our trained engineering staff will gladly survey your needs and tell you why "first cost" is a dangerous basis, in buying insulation.

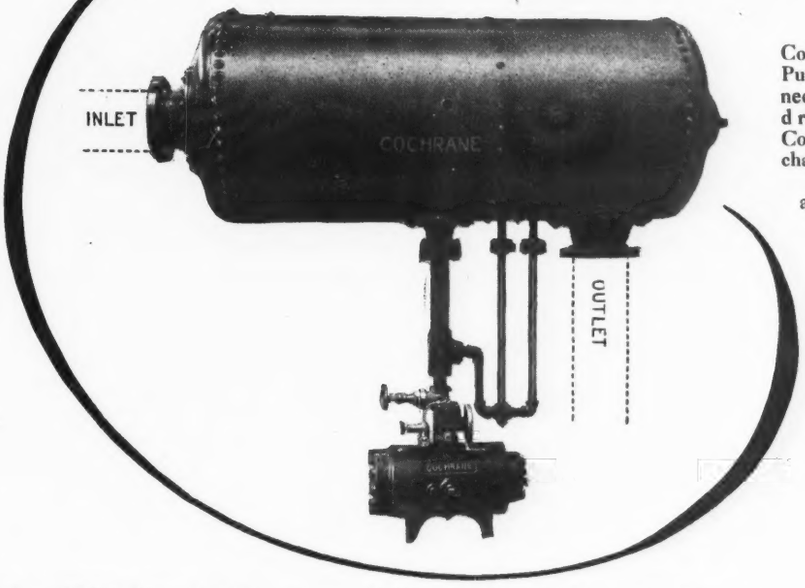
Originators of 85% Magnesia Covering

Keasbey & Mattison Company

AMBLER, —:— PENNA.

Boston, Mass. Syracuse, N. Y. Cleveland, O. Detroit, Mich. New York City
Baltimore, Md. Chicago, Ill. Washington, D. C. Minneapolis, Minn. Philadelphia, Pa.
H. G. Sperry Co., 415 Call Bldg., San Francisco, Calif. Dixie Asbestos Co., Birmingham, Ala. E. J. Eddy, Buffalo, N. Y.

Here It Is Mr. Prime Mover



Cochrane Steam Purifier as connected to and drained by Cochrane Discharger. (Patent applied for)

THE July, 1928, Serial Report of the Prime Movers Committee of the N.E.L.A. says:

> "Continental designers of boilers adhere to the use of a second steam separator drum above the main drum, even on high pressure designs. This assures dry steam to the superheater under adverse conditions of high ratings or wide fluctuation of water level in the main drum. In view of the difficulties encountered in certain stations in the United States, one wonders whether this design may not be worth copying for improved boiler operation at high rating."

The COCHRANE STEAM PURIFIER, Receiver Type, does all this and more. Installed in the steam line between the boiler steam drum and the superheater or turbine, it intercepts water and sludge, protects the superheater against scale and is conducive to uniform superheat.

The entire volume of the boiler steam drum proper remains available for water and steam storage and primary separation of water from steam, also for taking up fluctuations in water volume and level due to formation of steam bubbles at varying loads. Only one purifier is required for a multi-drum boiler.

High efficiency of separation is obtained even when the mixture entering the purifier consists of 50 percent or more of water by weight.

Ask for Cochrane Bulletin L-677, on "Steam Purification."

COCHRANE CORPORATION

17th and Clearfield Streets, Philadelphia, Pa.

468

"Merry Christmas" George Edwards—Engineer

Our Board of Directors met last week and declared the quarterly dividend for the stockholders. Then, upon our G. M.'s suggestion, an unusual event took place.

Each of us who stands at the head of a plant division was called in and asked to present a résumé of the things accomplished in the past year.

The G. M. had arranged with us beforehand so we could be prepared and the event went off in good shape. And then, when we were all finished, those same directors put their heads together once more and declared another division of profits, in the shape of a bonus this time, for the things, over and above routine if you wish, we had accomplished.

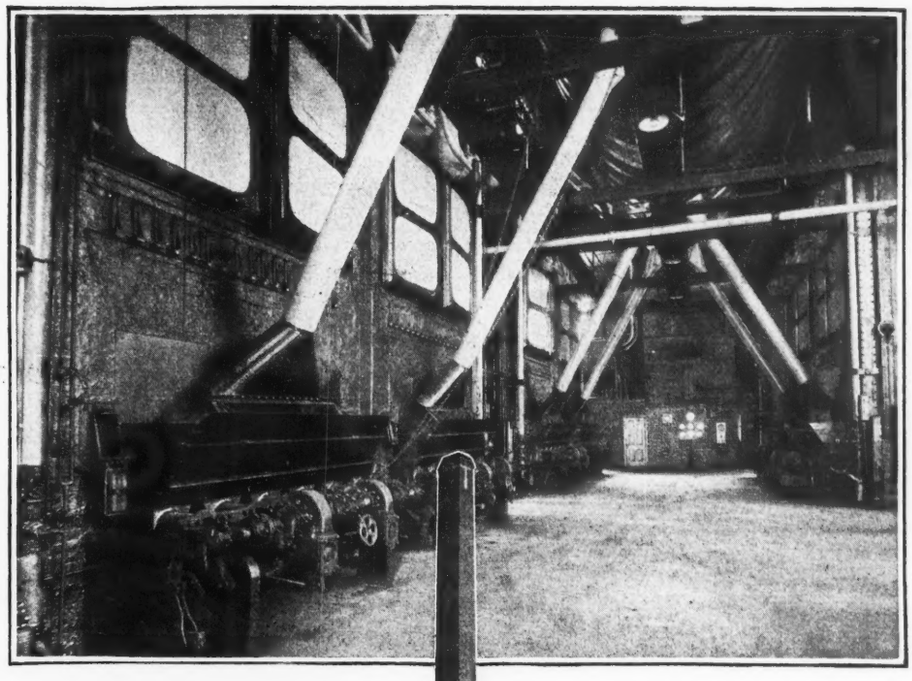
Why do I tell you all this? Because I want to point out what stood behind the talk I made in that meeting, what, in fact, made that talk possible for me.

I was a bit worried, at first, when the G. M. told me what he wanted me to do. Didn't know where to start. Then I had a hunch. Got out my old camera that I hadn't used for years, and took a dozen pictures in the plant at points we had improved during the year. Then dug out my back copies of POWER and clipped the ads responsible, in the main, for having started action in the first place. Next, I went to the purchasing department and collected the purchase orders with my specifications and copies of the approved appropriations which the Board had passed on to authorize the work. And finally, I secured copies of costs "before and after" from the accounting department.

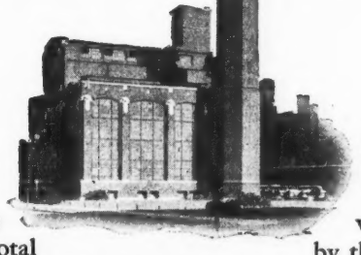
That took some time, true enough, but when I stood before those directors I had one beautiful picture of what can happen when advantage is taken of the things those ads told us. Incidentally, I pointed out a thing or two we can do in the year to come.

As I said, the event went off in good shape, and the bonus at this Christmas time was welcome indeed. But the point I want to make is that, once again, neither my improvements in the shop nor my speech to the Directors nor the resulting bonus, nor my hopes for 1929 could have been or expected to be without these ads in the advertising pages of my paper, POWER.

Gentlemen, to you who write these ads, and make my job worthwhile, I only want to say that here's one engineer representative of many thousand men in similar jobs who wishes for you a Merry Christmas and a more Prosperous New Year than you have ever known.



Ask the C.M.D. about Plibrico



THE plant shown opposite supplies heat and power for a total of four million square feet of floor space in buildings erected within the Central Manufacturing District at Chicago. The C. M. D. is the largest privately-operated industrial community in the world.

The six 500 hp. boilers shown above are in service at this plant and operate at ratings averaging 175%. Jointless Plibrico has been used since 1926. The six boilers now have complete linings of Plibrico. Mr. A. J. Biel, C. E., reports that Plibrico has made big economies.

Plibrico is firebrick in putty-like, plastic form. It takes the place of firebrick altogether. It is not used as a coating over old brick. Plibrico is installed in chunks with a mallet. It is then baked out by the first heat of the fire, giving a rock-like, one-piece lining that is resistant to 3100 deg. F. and that outlasts joint-weakened firebrick 2 to 4 times. It cuts heat loss and saves fuel by eliminating the leaky firebrick joints.

Why accept continual furnace repairing as a necessary evil? Use monolithic Plibrico for your next repair. You'll be pleased with its longer life.

Call in the local Plibrico engineer on your next job. There are warehouse stocks, estimating engineers, and installation and boiler setting facilities in 100 cities in the United States and Canada — see your phone book. Or mail the coupon for a free copy of "Cutting Furnace Costs"— 32 pages, standard filing size.

PLIBRICO *furnace lining*

REG. U.S. PATENT OFFICE

More than 20,000 users

☐ Send "Cutting Furnace Costs" — *free*

Repairs needed?_____

_____ When?_____

*Firm*_____

*Address*_____

_____

*Att'n*_____ *Title*_____

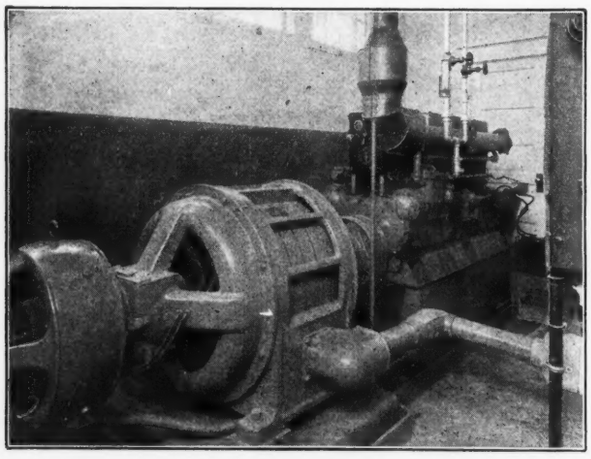
Mail to PLIBRICO JOINTLESS FIREBRICK CO. P-12-25-28
1844 Kingsbury St., Chicago (*Factories:* Chicago & Trenton)

THOUSANDS OF DOLLARS ? ? ? ?

are saved by this quick starting installation when utility power fails.

Sterling
High Duty
Internal
Combustion
Engines

12 to 565 B.H.P.
Gas or Gasoline Engines



Schott's Bakery, Houston, Texas, operated electrically, has employed this standby unit on several occasions to save bread from loss. A 150 K.V.A. 1200 R.P.M. G.E generator is driven by a direct connected straight 8 cyl. Sterling 240 H.P. engine.

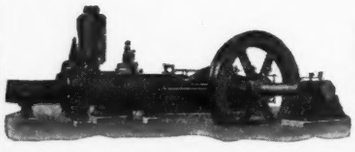
STERLING ENGINE COMPANY, Dept. C-1, Buffalo, New York

De Laval
Steam Turbine Co., Trenton, N.J.

Manufacturers of Steam Turbines, Centrifugal Pumps, Centrifugal Blowers and Compressors, Flexible Couplings, Double Helical Speed Reducing Gears, Worm Gears, Hydraulic Turbines and Special Centrifugal Machinery.

Atlanta	Duluth	Los Angeles	St. Paul
Boston	Havana	Montreal	Salt Lake City
Charlotte	Helena	New Orleans	San Francisco
Chicago	Honolulu	New York	Seattle
Cleveland	Houston	Philadelphia	Spokane
Denver	Indianapolis	Pittsburgh	Toronto
	Kansas City	Portland, Ore.	Vancouver

UNI-FLOW ENGINES



BOILERS
UNI-FLOW ENGINES
CORLISS ENGINES
TURBINES
GENERATOR UNITS
WATERWORKS PUMPS

MURRAY IRON WORKS CO.
INC. 1870
BURLINGTON, IOWA

Falls Engine Stop

Write for Bulletins.

Natural Gas and Blast Furnace Gas Burners
GAS COMBUSTION CO., Pittsburgh, Pa.

PENNSYLVANIA PUMP

Single Stage Double Suction
Centrifugal Pumps
Bulletin No. 206
PENNSYLVANIA PUMP AND COMPRESSOR COMPANY
Easton, Pa.

MOORE
STEAM TURBINES
CENTRIFUGAL PUMPS
MOORE STEAM TURBINE CORPORATION
Wellsville, N.Y.
"BEST AT EVERY TURN"

Vogt PRODUCTS
REFRIGERATING AND ICE MAKING MACHINERY—WATER TUBE & HORIZONTAL RETURN TUBULAR BOILERS DROP FORGED STEEL VALVES & FITTINGS—OIL REFINERY EQUIPMENT—*Ask for Bulletins*
HENRY VOGT MACHINE CO., Manufacturers, Louisville, Ky.

Water softening process improved by— Sodium Aluminate

This process has been improved in the last few years by the addition of sodium aluminate. This eliminates the three grams of hardness which the former treatment left and which under adverse conditions of rapid evaporation at the cooling pond or tower caused a concentration of the processed water, rendering the once processed water hard enough to form scale.
By using the lime-soda ash-soda aluminate treated water, an excess of sodium hydrate can be carried to prevent corrosion in the cooling system and maintain the water at zero hardness when there is danger of contamination with outside water, as for instance when makeup water is added.
Letters from an Oil Engine Operator
On the Use of Water Softeners
What Is Power?

From
Nov. 6 Power

E. O. L. gave Ed some good advice when he stated the need for efficient water treatment so clearly and advised him to consult a firm capable of giving intelligent co-operation. In spite of his modesty, E. O. L. shows himself pretty well informed on water treatment.

K. W. S. engineers are always ready to help—even to making a free survey of your present system of treating, results obtained, etc. Sometimes there is nothing we can do to improve conditions, but our work has made us many friends and a steadily increasing number of plants are finding that the K. W. S. system can improve on even good water treatment.

Treat your water right and it will treat you right.

Have you seen our series of actual surveys showing results achieved by K.W.S. Sodium Aluminate and K.W.S. system of water treatment used in both external and internal treating for steam plants, and distilled or raw water ice plants? We will be glad to send you copies of recent results surveys made, or any literature covering particular conditions in which you may be interested. The coupon is for your convenience. Send the coupon. No obligation.

K.W.S.
SODIUM ALUMINATE

Send the coupon——No obligation

National Aluminate Corporation
6222 W. 66th Place
Chicago, Illinois

☐ You may survey our water condition.

☐ You may send a representative to explain K.W.S. service.

You may send literature on:

☐ External treatment of boiler water.

☐ Internal treatment of boiler water.

Name .....

Address .....

Company .....

NATIONAL ALUMINATE CORPORATION
CHICAGO

6222 West 66th Place

Specialists in water softening, filtration, process work, waste water disposal, and all problems involving water supply and treatment. Manufacturers of National dry chemical feeders.

Representatives in Principal Cities

P 12-25Gray

STEAM for Industrial Power and Process

The steam demand in industrial plants must be met promptly and with reliability. The boiler installation with its auxiliaries should be selected giving full consideration to range of loads, steam pressure, superheat, fuel, water conditions, and space available. In all cases it is desirable to generate steam with a high commercial efficiency, that is an efficiency which not only includes fuel economy but also investment, operation and maintenance costs.

In order to supply boilers best suited to the individual plant requirements, Wickes offers four types of Proven Units —the Horizontal Return Tubular; Water Tubes—Vertical, Horizontal Cross Drum, and Three Drum Curved Tube.

TEN RECENT INSTALLATIONS

*Dow Chemical Co., Midland, Mich.
2— 805 h.p. Horizontal Cross Drum.
1—1511 h.p. Horizontal Cross Drum.
1—1513 h.p. Three Drum Bent Tube.
1—1513 h.p. Three Drum Bent Tube.

*Watervliet Paper Co., Watervliet, Mich.
3—610 h.p. Three Drum Bent Tube.

*Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich.
2—1006 h.p. Three Drum Bent Tube.

*Timken-Detroit Axle Co., Detroit, Mich.
2—668 h.p. Three Drum Bent Tube.

Garlock Packing Co., Palmyra, N. Y.
2—505 h.p. Horizontal Cross Drum.

*Electric Refrigeration Corporation (Leonard Division), Grand Rapids, Mich.
2—508 h.p. Vertical Water Tube.
1—508 h.p. Vertical Water Tube.

*Riverside Fibre Co., Appleton, Wis.
2—408 h.p. Horizontal Cross Drum.

Kohler Company, Kohler, Wis.
2—515 h.p. Horizontal Cross Drum.
2—515 h.p. Horizontal Cross Drum.

Fox River Paper Co., Appleton, Wis.
4—507 h.p. Horizontal Cross Drum.

American Seating Co., Grand Rapids, Mich.
3—400 h.p. Vertical Water Tube.
1—502 h.p. Vertical Water Tube.

*This is a repeat order for Wickes Boilers and does not represent the total horsepower installed.

You are invited to write for Bulletins describing Wickes Boilers.

THE WICKES BOILER CO.
Established 1856
SAGINAW, MICHIGAN
SALES OFFICES:
New York, 501 Fifth Ave. Pittsburgh, 1218 Empire Bldg. Chicago, 33 S. Clark St.
Seattle, 736 Henry Bldg. Detroit, General Motors Bldg.

THE BABCOCK & WILCOX COMPANY

85 LIBERTY STREET, NEW YORK

Builders since 1868 of Water Tube Boilers of continuing reliability

BRANCH OFFICES
ATLANTA, Candler Building
BOSTON, 80 Federal Street
CHICAGO, Marquette Building
CINCINNATI, Traction Building
CLEVELAND, Guardian Building
DALLAS, TEXAS, Magnolia Building
DENVER, 444 Seventeenth Street
DETROIT, Ford Building
HOUSTON, TEXAS, Electric Building
LOS ANGELES, Central Building

THE BABCOCK & WILCOX COMPANY — STEAM

WORKS
Bayonne, N. J.
Barberton, Ohio

Makers of Steam Superheaters since 1898 and of Chain Grate Stokers since 1893

BRANCH OFFICES
NEW ORLEANS, 344 Camp Street
PHILADELPHIA, Packard Building
PHOENIX, ARIZ., Heard Building
PITTSBURGH, Farmers Deposit Bank Building
PORTLAND, ORE., Failing Building
SALT LAKE CITY, Kearns Building
SAN FRANCISCO, Sheldon Building
SEATTLE, L. C. Smith Building
HONOLULU, T. H., Castle & Cooke Building
HAVANA, CUBA, Calle de Aguiar 104
SAN JUAN, PORTO RICO, Recinto Sur 51

SPRINGFIELD BOILERS

WATER TUBE BOILERS
SECTIONAL
ALL STEEL
Springfield Boiler Co.
Springfield, Ill.

COATESVILLE
BOILERS - TANKS - STEEL PLATE WORK
Over 40 Years Experience
COATESVILLE BOILER WORKS
Coatesville, Pa.

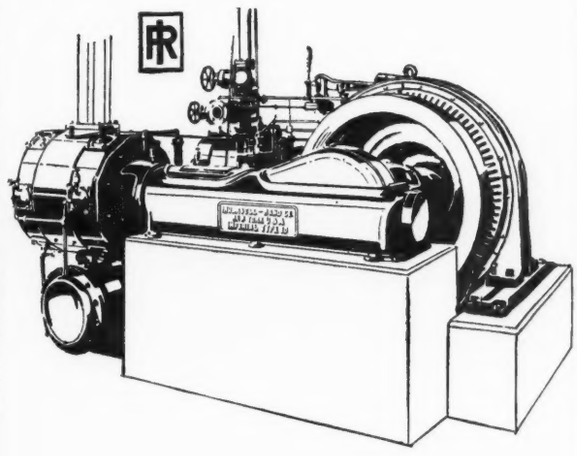
HEDGES-WALSH-WEIDNER COMPANY

Subsidiary of International Combustion Engineering Corp.

CHATTANOOGA, Tenn.

Boilers for working pressures to 1600 lb. Sizes to 45,000 sq. ft.

Forged Steel Sectional Header Boilers
Stay-Bolted Header Boilers
Horizontal Return Tubular Boilers
4 Drum Semi-vertical Water Tube Boilers
3 Drum Semi-vertical Water Tube Boilers
5 Drum Multi-pass Water Tube Boilers
Water Walls and Furnace Bottoms



A Dependable Supply of Compressed Air at Low Cost

With the rapid development of electric power, it has become evident that direct connection to synchronous motors is, in a great many cases, the ideal type of drive for Compressors. Ingersoll-Rand Company has been a pioneer in this work and has constantly forged ahead in the development of such type of machine.

The Type XRE Compressors shown above are of the synchronous-motor-driven type and are available in sizes as small as 100 hp.

Proper unloading and regulation for these machines have been so developed in our 5-step Clearance Control Regulator that the most flexible demand is automatically and efficiently accommodated. With this patented control, the power input is practically proportionate to the load, whether the machine be operating at full, three-quarter, half, one-quarter, or no capacity.

Ingersoll-Rand representatives are located in all parts of the world. They will be glad to consult with you on your Compressed Air problems.

INGERSOLL-RAND COMPANY
11 Broadway : New York City

Offices in Principal cities the world over

For Canada refer—Canadian Ingersoll-Rand Co., Limited
10 Phillips Square, Montreal, Quebec

Ingersoll-Rand

892-C

Free Holiday Stamping Offer

Until January 1st, 1929, we will stamp your name, or a friend's name, in gold on the front cover of this book without additional charge. Orders for stamped copies should be accompanied by price, and of course, stamped books are not returnable.

Refrigeration

Including Household Automatic Refrigerating Machines

By James A. Moyer and Raymond A. Fittz

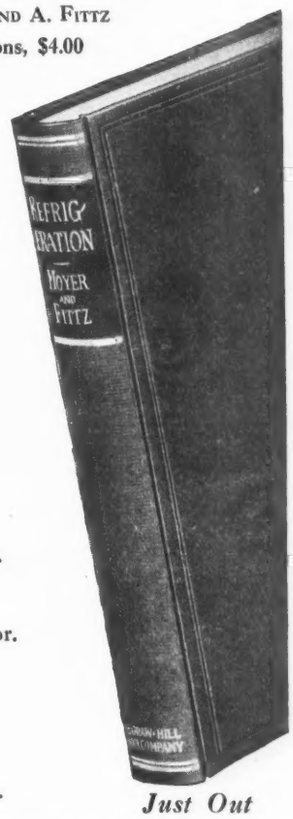
431 pages, 6x9, 184 illustrations, $4.00

A thorough treatment of the theory, operation and testing of modern refrigeration systems, for:

—the operating Engineer in refrigeration plants,

—the mechanical Engineering student,

—the man engaged in servicing and installing household refrigerating equipment.



Complete Information on:—

The Air System.
The Compression System.
The Absorption Ammonia System.
The Vacuum System.
The Vap-Air System.
The Audiffren-Lingrun Refrigerator.
General Electric Refrigerator.
Frigidaire.
Kelvinator.
Welsbach.
"Icyball."
Electrolux Servel Gas Refrigerator.

Just Out

The book begins with a thorough explanation of refrigeration methods and systems of refrigeration. It discusses the theory of refrigeration and the chemistry of the subject. The various types of equipment are described in detail and their operation and testing carefully explained. Household Automatic Refrigerating machines receive special attention. Particularly interesting also, are the discussions of ice making, cold storage construction, air conditioning and cooling and the cold storage of foods.

Order a copy Now

McGRAW-HILL FREE STAMPING OFFER COUPON

McGraw-Hill Book Co., Inc., 370 Seventh Avenue, New York.

Send me **Moyer & Fittz, Refrigeration, $4.00,** with name stamped in gold on front cover. I enclose proper remittance and understand that stamped copies are not returnable. **(This offer expires Jan. 1, 1929.)**

.....
(Name to be stamped)

Signed .....

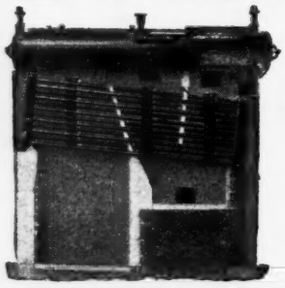
Address

Official Position .....

Name of Company .....

P. 12-25-24

UNION WATER TUBE BOILERS



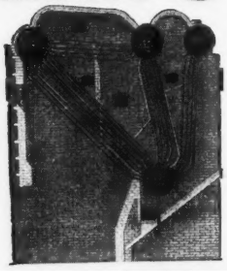
Standard longitudinal drum boiler.
Also made in cross drum type.

UNION BOILERS are built in longitudinal drum, cross drum and vertical bent tube types for practically all operating pressures and sizes.

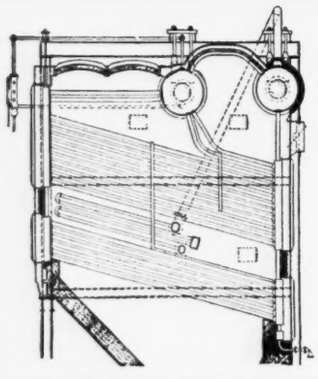
Designed and built by an organization backed by forty years experience in the manufacture of high pressure steam boilers exclusively, in a modern and specially equipped plant.

Sales offices in principal cities are at your service.

ERIE UNION IRON WORKS PENNA.



Also made as three drum boiler and with integral front water wall (patented) in either type.



The Connelly Sectional Header CROSS-DRUM Boiler—

PRODUCES the same important first few degrees of superheat that you get from the famous Connelly bent-tube boilers. Built with either one or two cross-drums and can be manufactured in units up to 35,000 sq. ft. of heating surface and for steam pressures up to 1400 lbs.

Catalogs on either type of Connelly boiler will be sent promptly. Write

53 years of knowing how!

The CONNELLY BOILER COMPANY 1170 Ivanhoe Rd. Cleveland Ohio

Water Tube Boilers for Every Service

BOILERS of high quality for central stations and industrial plants of all sizes, and for utilization of waste heat from kilns and furnaces. Steel construction only. Straight tube and bent tube types. Noted for long life and economy of operation.

Engineering service available—wire or write.

EDGE MOOR IRON COMPANY Edge Moor, Delaware

EDGE MOOR Water Tube BOILERS

STRAIGHT AND BENT TUBE TYPES—WATER WALLS—AIR PREHEATERS

KINGSFORD

All Steel Sectional Water Tube Boilers

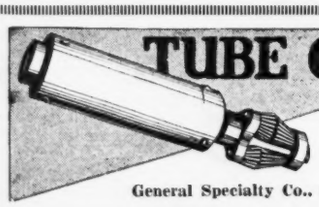
A design and construction that has proved its high efficiency under all steaming conditions. Also builders of horizontal and vertical Unaflow Engines and all types of Centrifugal Pumps. Write for Catalog.

Kingsford Foundry & Machine Works, Oswego, N. Y.

Lagonda Tube Cleaners

Tube Cutters, Reseating Machines

The LAGONDA MANUFACTURING CO., SPRINGFIELD, O.

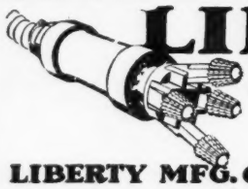


TUBE CLEANERS

For water tube and fire tube boilers.

Write for FREE TRIAL offer and bulletins.

General Specialty Co., 67 Carroll St., Buffalo, N. Y.



LIBERTY CLEANERS

for all sizes and types of tubes

LIBERTY MFG. CO., JEANNETTE, PA.

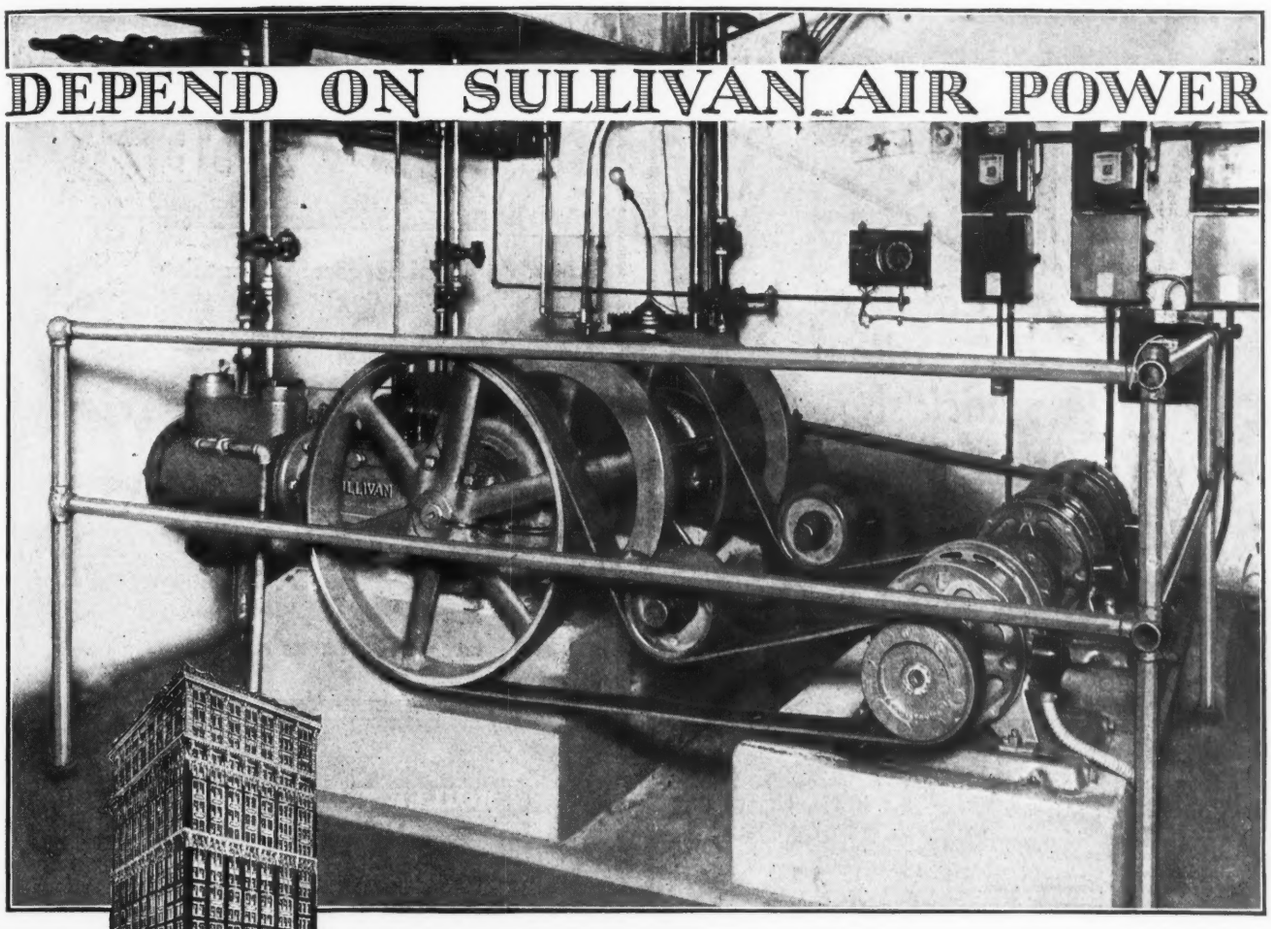
BOILER TUBES

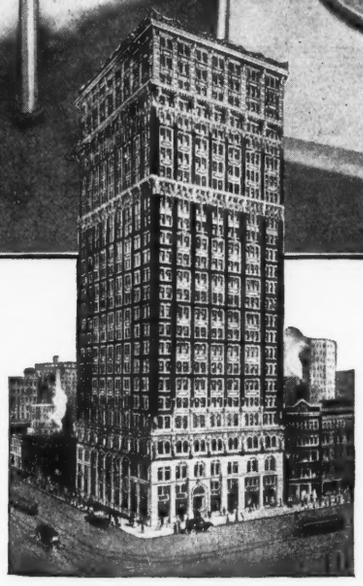
Straight and Bent Boiler Tubes accurately fabricated to your specifications. Large capacity. Skillful Workmanship. Quick service on all orders.

STANDARD WIRE & TUBE COMPANY, Mineral Ridge, Ohio

Successors to American Tube and Pipe Bending Co., The Standard Wire Co., Ridge Stamping and Fabricating Co.

DEPEND ON SULLIVAN AIR POWER





Two Sullivan "WG-6" Compressors supplying compressed air to the Farmers Bank Building, Pittsburgh.

Dependable Air Power in a Pittsburgh Office Building

Down below the street, in numerous office buildings, and hotels, Sullivan Compressors work silently, automatically, and dependably, supplying air for many important tasks.

The picture shows two Sullivan "WG-6" Compressors at work in the Farmers Bank Building, Pittsburgh. They supply air principally for sewage ejectors and for barber shops.

But there are many other needs for compressed air in buildings. Furnace dampers, elevator doors, doctors' and dentists' apparatus, jewelers' furnaces and blowers, and other equipment make the dependability of Sullivan Compressors a valuable asset.

For more than 20 years, Sullivan Compressors have supplied air power to every industry—to factories, shops, power plants, mines, quarries, and construction projects.

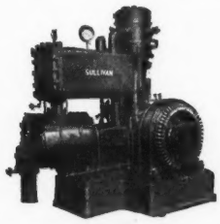
They are available in capacities from 68 to 5100 cu. ft. per min.; in single- and two-stage machines; and adapted to drive by belt, or direct connection to electric motor, or to oil engine.

Send for Catalogs.

Don't miss the Sullivan Exhibit at the Road Show in Cleveland, January 14th to 18th, Booths WW-15 and 45, West Wing

Sullivan Machinery Company
132 S. Michigan Ave., Chicago

From the Sullivan Line



Sullivan Balanced "Angle Compound" Compressors are known for their economy of power, maintenance, foundations and floor space. Capacities 313 to 5100 cu.ft. *Catalog 83-J.*

SULLIVAN
TRADE MARK
New York Boston Pittsburgh Cleveland

BOILER TUBES

Large stocks allow quick shipments

When boiler tubes go out repairs mark time until the new ones arrive. Our large warehouse stocks allow us to make prompt shipment to all localities.

Write for information and prices.

THE TYLER TUBE & PIPE CO.
WASHINGTON, PA.

WAREHOUSE STOCKS: Boiler Tube Co. of America, Pittsburgh and Brooklyn; John McKenzie & Co., Inc., Baltimore; Tidewater Supply Co., Inc., Norfolk, Va., Columbia, S. C.; Joseph T. Ryerson & Son, Inc., Cincinnati, Cleveland; A. M. Castle & Co., Chicago, Seattle, San Francisco, Los Angeles; Lukens Steel Co., New Orleans; Harrisburg Pipe & Pipe Bending Co., of Texas, Inc., Houston, Texas; Harrisburg Supply Co., Tulsa, Oklahoma.

Special Representatives: W. M. MacCleary, 2 Rector St., New York; W. H. S. Bateman & Co., Philadelphia.

New England Representative: George W. Denyven, 250 Stuart St., Boston.

FAST SERVICE

YOUR order for immediate shipment does not mean next week or next month—it means NOW! Yet the workmanship is perfect.

Huge and complete stocks of boiler tubes, plus accurate cutting and bending, are the answer. Our tubes are the product of nationally known manufacturers. For fast service—*write, phone or wire us.*

"World's Fastest Boiler Tube Service"

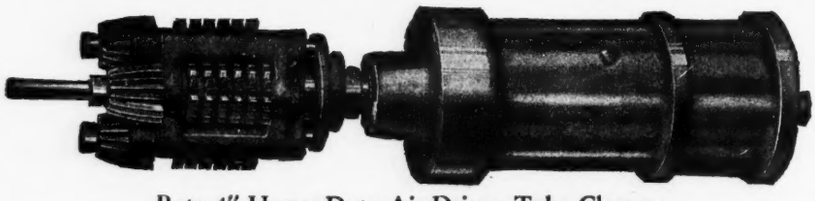
BOILER TUBE COMPANY OF AMERICA

CHICAGO NEW YORK

Main Office and Works:
3124 Preble Avenue, PITTSBURGH, PA.

Four Cleanings a Year May Be Cheaper Than One

The average cleaning time per boiler is reduced by more frequent cleaning and more uniform efficiency of the boiler is maintained.



Roto 4" Heavy Duty Air-Driven Tube Cleaner

THE ROTO COMPANY, Sussex Ave. and Newark St., NEWARK, N. J.

HUNT

Tension Adjusting Couplings

Take up the stretch in your English System rope drive—they twist up the rope with it in position on the pulleys—no splicing costs nor delays. Ropes furnished complete fitted with couplings.

Ask for our 50-page catalogue, C-26-1, treating of rope transmission, also describing the Hunt coupling and "Stevedore" Transmission Rope.

C. W. HUNT CO., INC.
WEST NEW BRIGHTON, N. Y., U. S. A.

APEXIOR
REG. U.S. PAT. OFF.

—an accepted protective coating for hot water and steam surfaces of boiler plant equipment.

Write for Bulletin

The DAMPNEY CO. OF AMERICA, Hyde Park, Mass.

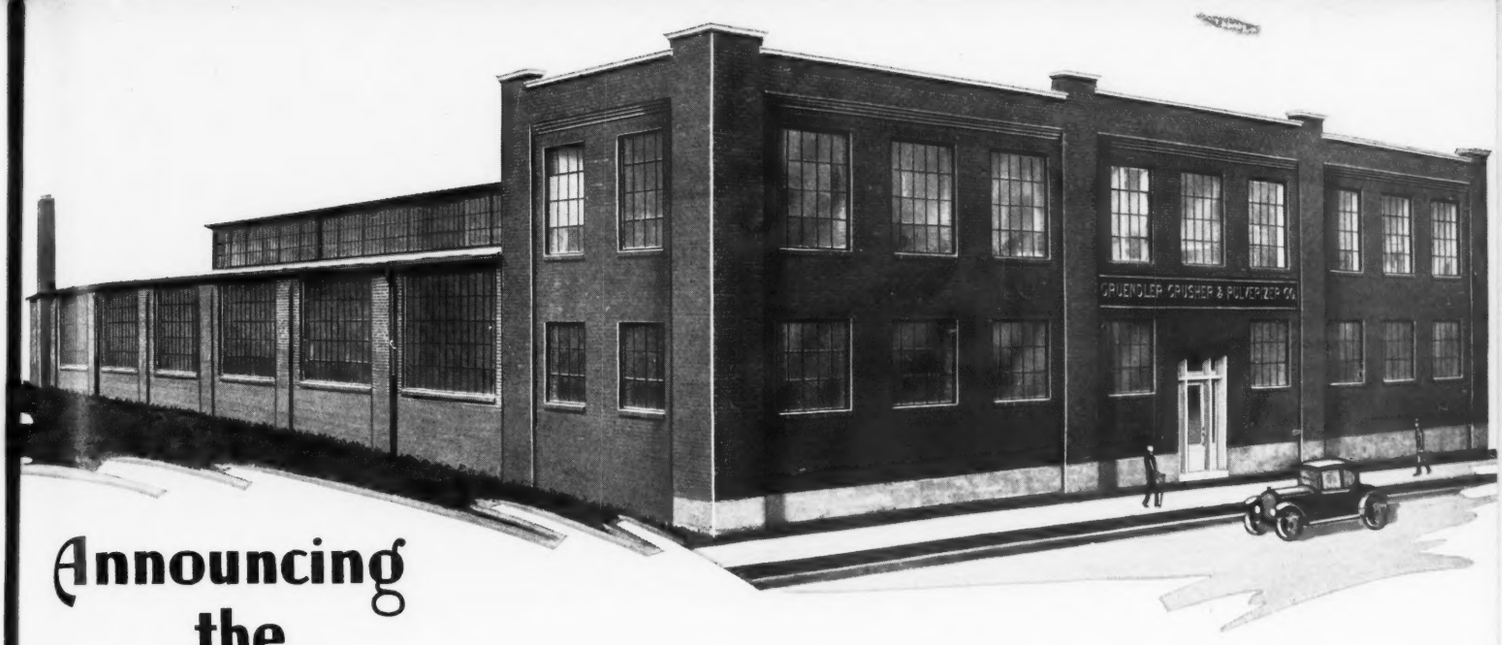
"MAGIC" Boiler Preservative

Twenty-Five Years' Experience!

Positive proof that "Magic" WILL do the work, i.e., prevents and stops scale formation, minor leaks, pitting and corrosion.

MAGIC
"THE FILM FOR BOILERS"

GARRATT-CALLAHAN CO.
New York CHICAGO San Francisco



Announcing the New Plant

GRUENDLER

THIS month we inaugurate our New Plant at 29th and North Market Streets—the new home of Gruendler Crushers and Pulverizers!

Modern in every respect, the New Plant is the response to a nation-wide demand for Gruendler equipment—a demand that has made necessary the increased facilities and increased production now possible.

There is a significance to this new and greater building that goes beyond the structure, itself. It is a spirit which, though intangible, is of prime importance.

For the New Gruendler Plant—like Gruendler Crushers and Pulverizers—is the result of 44 years' experience in the manufacture of dependable equipment for crushing, grinding and mixing. It is a fitting monument to Gruendler Efficiency—and Gruendler Quality!

No Postage Stamp Necessary If Mailed Before Nov. 30, 1929

Postage Will Be Paid By Addressee

BUSINESS REPLY CARD
FIRST CLASS PERMIT NO. 342, SEC. 3841/2, P.L.&R., ST. LOUIS, MO.

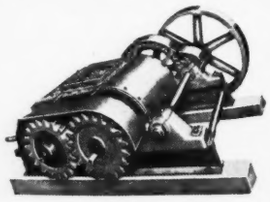
Gruendler Patent Crusher and Pulverizer Co.
29th and North Market Streets
St. Louis, Mo., U. S. A.

ANNOUNCING NEW FEATURES IN GRUENDLER EQUIPMENT

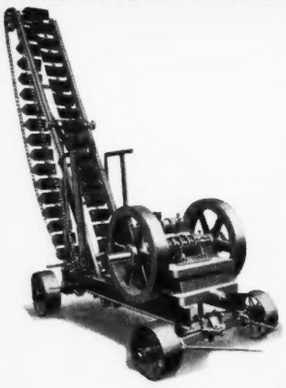
Time and test have won for Gruendler Crushers the title: *America's Leading Hammermills.* For, through almost a half-century, they have stood the test of actual performance under all conditions, as is evidenced by thousands of successful Gruendler installations. Scientifically correct in design, sturdy and dependable in construction—Gruendler Crushers give maximum production at minimum operating cost. Their ability to do just that makes Gruendler Hammermills the ideal crushers for *your* plant. Get the facts on the new Gruendler products and improvements for your field. Without any obligation, clip, check and return the attached post-card now.

Swing hammer crusher and pulverizer for rock, coal, cement, clay, etc.

Centrifugal ring crusher for coal, iron ore, steel turnings.

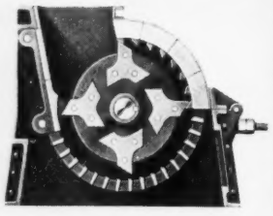


Double roll crushers for double belt or gear driven. For granulating and for the crushing of coal or stone into a fine, uniform product.

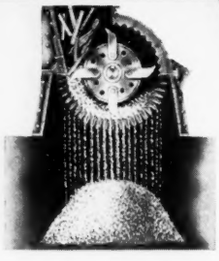


Portable jaw crushers for road-making—the most modern maintenance unit.

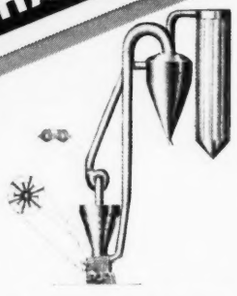
AMERICA'S LEADING HAMMERMILLS



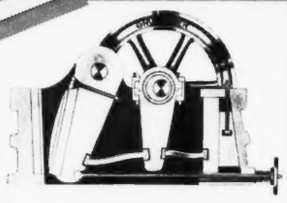
Rigid hammer shredder and crusher for bones and carcasses in rendering plants; also coal cracking and special work.



Wood hog—for wood refuse, bark, pulp and rechipping.



Centrifugal roll and beater mills for fine grinding of dry products up to 300 mesh. Air separation.



Jaw crushers for preliminary crushing of rock, gravel, asphalt rock, ore and many other materials.

GRUENDLER PATENT CRUSHER and PULVERIZER CO., *St. Louis, Mo.*

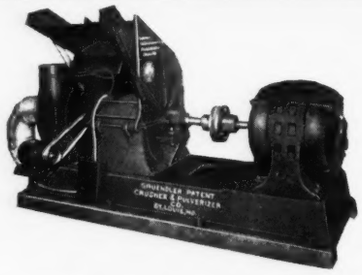
We are interested in your improved equipment for the field, checked below. Without obligation on our part, please send us complete information on:

- ☐ General Purpose Crushers and Pulverizers.
- ☐ Coal Crushers and Pulverizers.
- ☐ Bone, Tallow and Cracklings Grinders.
- ☐ Heavy Chemical Crushers and Pulverizers.
- ☐ Alfalfa Grinding Machinery.
- ☐ Screenings and Bran Pulverizers.
- ☐ Custom Grinding Machinery.
- ☐ Cement and Rock Crushers.
- ☐ Rock and Gravel Crushers.
- ☐ Crushers for By-Product Coke Plants.
- ☐ Wood Hogs and Shavings Pulverizers.

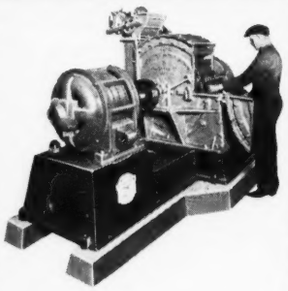
Name .....

Firm .....

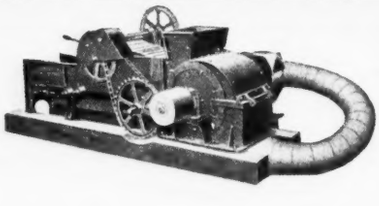
Address .....



Whirl beater for custom feed grinding. Hammer type with built-in spout magnet.



Peerless fine grinder. Grinds shavings into sawdust or wood flour; also bran, grain and mixed feed.



Shredder with hopper and force feed table—for hay, waste paper, cornstalks, ear corn, etc.

Portable pulverizers for crushing limestone, coal, gravel, etc.

Your Firemen Can Read

this 12 inch scale from 50 feet away

And that is one of the important features of Ranarex design—its large, easily read dial. But it is not the most important feature, for Ranarex is the only CO_2 Recorder that is completely mechanical.

There are three types of CO_2 Recorders on the market today.

1—Those using chemicals.

2—Electrical CO_2 Recorders.

3—The Mechanical CO_2 Recorder (Ranarex) that can be kept in perfect running order by any mechanic with a wrench and a screw driver.

This mechanical principle of operation has many advantages for the practical boiler plant operator. It eliminates the need for delicate parts, small orifices, running water, etc. It assures a short time lag which is very desirable, and it enables us to build a rugged, dependable instrument that will stand up under adverse boiler room operating conditions.

It is worth your while to know more about Ranarex. Let us send you our bulletin "Reducing the Stack Loss" —no obligations.

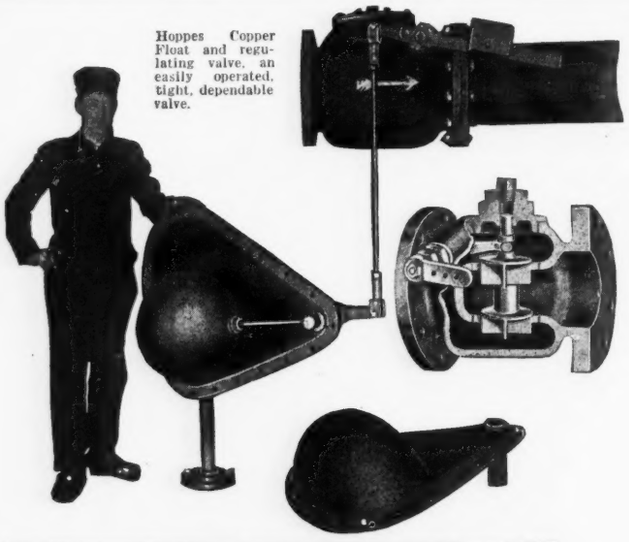
These well-known firms use Ranarex

	Units
U. S. Government Plants	52
Cons. Gas Co. of N. Y.	40
Standard Oil Co. of N. J.	38
E. I. Du Pont De Nemours	21
Detroit City Gas Co.	15
General Motors	15
Champion Porcelain Co.	14
Viscose Co.	11
United Gas Improvement Co.	10
Columbia Power Co.	9
Exeter Power Co.	8
Standard Oil Co. of Ohio	8
General Electric Co.	8
Armstrong Cork Co.	8
Amercian Steel & Wire Co.	8
Hammermill Paper Co.	7
International Paper Co.	7
John B. Stetson Co.	7
Consolidated Paper Co.	7
Consumers Power Co.	7
Utica Gas & Electric Co.	6
Penn & Ohio Power and Light Co.	6
Dayton Power & Light	6
Central Power & Light	6
Tampico Electric Co.	5
The Texas Co.	5
Toledo Furnace Co.	5
Beaver Products Co.	5
Michigan State College	5
N. Y. Central R.R.	5
Brooklyn Union Gas Co.	5

The Permutit Company

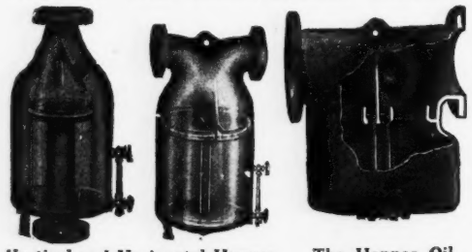
BOILER AUXILIARIES

MAIN OFFICE: 440 FOURTH AVENUE, NEW YORK — BRANCH OFFICES IN ALL PRINCIPAL CITIES



Hoppes Copper Float and regulating valve, an easily operated, tight, dependable valve.

FOR DRY AND CLEAN STEAM—ALWAYS



Vertical and Horizontal Hoppes Steam Separators

The Hoppes Oil Eliminator

HOPPES

COPPER FLOATS give long lasting service

Made from high quality, heavy gage copper by a modern spinning process and reinforced with inside bands of copper. The floats are supported on a rod which is pressed into a copper tube that extends across the float diameter. All seams are solder sweated and the entire outside surface is heavily copper plated.

HOPPES COPPER FLOATS—are a safe selection for the most important float controls. Used in many services.

The Hoppes Catalog describing the entire Hoppes line of Feed Water Heaters, Purifiers, Meters, Exhaust Heads, Steam Separators and Oil Eliminators will be sent upon request. ***Write today for your copy.***

The Hoppes Manufacturing Company
19 Larch St., Springfield, Ohio

To Open Drains

"Headin' South"

This letter tells its own story:

Oct. 5, 1928.

"Dearborn Chemical Company:

During the initial performance of McIntyre and Heath's new show entitled 'Headin' South', the drain leading from the circulating water drinking fountain in the main lobby became clogged with cigarette butts and other debris which we were unable to remove by hand force pumps or other mechanical means. The water overflowed onto the rugs and floor.

"We resorted to the use of your No. 7 Cleaner and are very pleased to tell you that it cleaned the clogged pipe thoroughly and very successfully in about ten minutes.

"Your material is all that you claim for it and more too.

"B. F. Keith Theater Building,
"J. F. Derrickson, Supt."

There is a first-rate Dearborn Cleaner for every service you can have. Try it. Write.

DEARBORN CHEMICAL COMPANY

310 S. Michigan Avenue, CHICAGO
NEW YORK, 299 Broadway

Canadian Offices and Factory:
2454-64 Dundas Street, West, Toronto

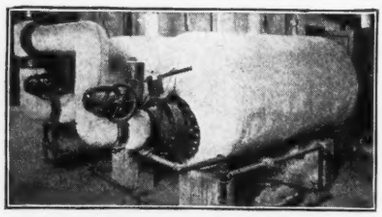
Cleaner No. 7

For Hot Water—

Whether your need is for feed water, a heating system or a manufacturing process or a domestic purpose—the cost will be less if you heat the water in

ALBERGER-BUFFALO Heaters

Scientifically designed for high heat transfer, with Helically corrugated copper tubes. Divided floating tube head that eliminates expansion stress. Consult us on your requirements. Write.



ALBERGER HEATER CO., HOWARD IRON WORKS
283 Chicago St., Buffalo, N. Y.

Ljungström AIR PREHEATER

Reg. U.S. Pat. Off.
CONTINUOUS REGENERATIVE COUNTERFLOW

Recovers 70% stack heat, raises CO_2, improves combustion—*Bulletin on request.*

THE AIR PREHEATER CORPORATION
25 Broadway, N. Y. Works, Wellsville, N. Y.

THERMIX AIR HEATER and THERMIX STACK

THERMIX AIR HEATER. Plate type; for recovery of heat in flue gas. *Write for Catalog 10-T.* THERMIX STACK. Fan and Stack built as a unit. *Write for Catalog No. 10-S.* THERMIX CINDER REMOVING STACK. Fan and cinder remover combined as a unit, with or without stack. *Write for Catalog No. 10-C.*

PRAT-DANIEL CORPORATION, 101 Park Ave., New York, N. Y.

KELLY

Improved Hand Stoker

Savings of 25% in cost of fuel is not an unusual record where the Kelly Improved Hand Stoker has been installed. It not only affords an extremely high combustion efficiency, but it makes available such cheap fuels as slack coal, coke breeze, and wood refuse.

The Kelly eliminates slicing, reducing the labor of the fireman and releasing him for other work.

cuts fuel costs !

Write for full information.

THE KELLY FOUNDRY & MACHINE CO.
614 NINTH ST. Est. 1887 GOSHEN, INDIANA

Chicago Office
178 W. Adams St.

New York Office
53 Park Place

Easy to install
Easy to operate
Backed by complete
Kelly service

The Kelly Hand Stoker Grate in the flat or normal fuel burning position.

THE MARION LINE

SOOT BLOWERS
STOKERS
GRATES

→ Save the coal ←

MARION MACHINE FOUNDRY & SUPPLY CO.
MARION, INDIANA

Increased Boiler Rating With Low Priced Fuel

A result of Coppus Forced Draft Blowers

FORCED DRAFT • BLOWER •

DO NOT CHANGE YOUR CHIMNEY OR PUT IN ANOTHER BOILER BEFORE READING BOOKLET NO. 145.

REGISTERED COPPUS U.S. PAT. OFFICE ENGINEERING CORPORATION
350 PARK AVE. WORCESTER, MASS.

CENTRIFUGAL TURBO BOILER FEED PUMPS • STEAM TURBINES • MINE VENTILATING BLOWERS

CYCLONE GRATES

Make *all* of your fuel count in power.
Write for Full Details.
CYCLONE GRATE BAR CO.
9 Grimes St., Buffalo, New York

GREEN'S
HI-EFFICIENCY HI-SPEED
RADIAL FLOW FANS

Let them supply your forced draft at a large saving in operating and upkeep cost.

Built in sizes to handle from 1600 to 275,000 cu.ft. per minute at pressure up to 7 inches of water.

Learn why they are more efficient. Write for Bulletin No. 152.

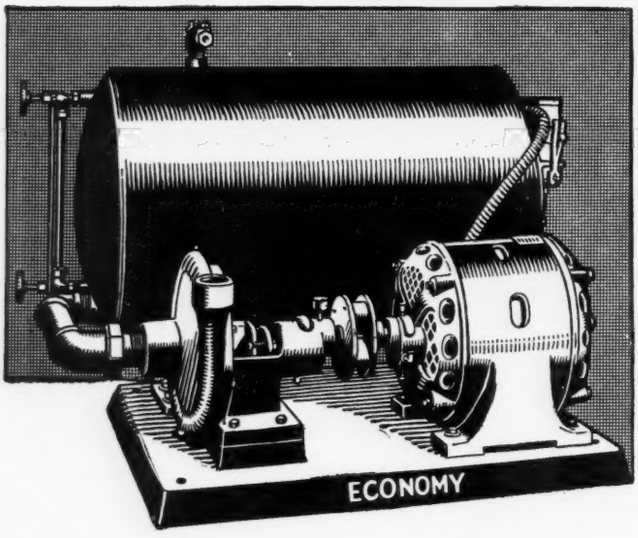
THE GREEN FUEL ECONOMIZER CO.
BEACON, N.Y.

FOR EVERY BOILER — STOKERED OR HAND FIRED

WING BLOWERS

7TH AVE. & 14TH ST. NEW YORK

Depend Upon It . . .
This Pump Is Always Ready



How satisfying—to know that even under abnormal conditions your pumps will work day in day out, year in year out, without interruption or big maintenance costs!

It is constant simplification of design, high quality of metals used in manufacture, and care in assembly that makes Economy Pumps so sturdy. This sturdiness is attested by many cases in which these pumps have operated steadily for 20 years with only minor repairs.

Add to this merit Economy's unusually high efficiencies and engineering advice in application, and you have the reason for the high prestige these pumps have won.

Specify a pump that will save you money—let our engineers recommend and work with you in installation.

Check bulletin you wish on this list, and send:
Bulletin
No. 405 Pumps and Receivers
No. 406 Horizontal Split Case Multi Stage Centrifugal Pumps
No. 407 Centrifugal Sump Pumps
No. 408 Single Stage Double Suction
No. 409 Non-Clogging Sewage Pumps
No. 410 Air Line Vacuum Pumps
No. 411 Electric Caisson and Mine Sinking Pumps

ECONOMY PUMPING MACHINERY CO.
3431 West 48th Place
Chicago

Representatives in principal cities—telephone and address under Economy Pumping Machinery Company

Economy Pumps

DETROIT UNDERFEED STOKERS
Ask For Bulletin 879
Detroit Stoker Company
879 General Motors Bldg - Detroit.

SMOOT CONTROL
A complete system—for machine regulation of any number of boilers from one central point. Many prominent installations.

Smoot Engineering Corporation
136 Liberty St., New York City
Leaders in Modern Combustion Control

LACLEDE CHAIN GRATE STOKER
The stoker for the higher volatile coals, dominant in this field today.

Full Details Will Be Sent on Request

LACLEDE STOKER CO., 4438 Hunt Ave., St. Louis, Mo.

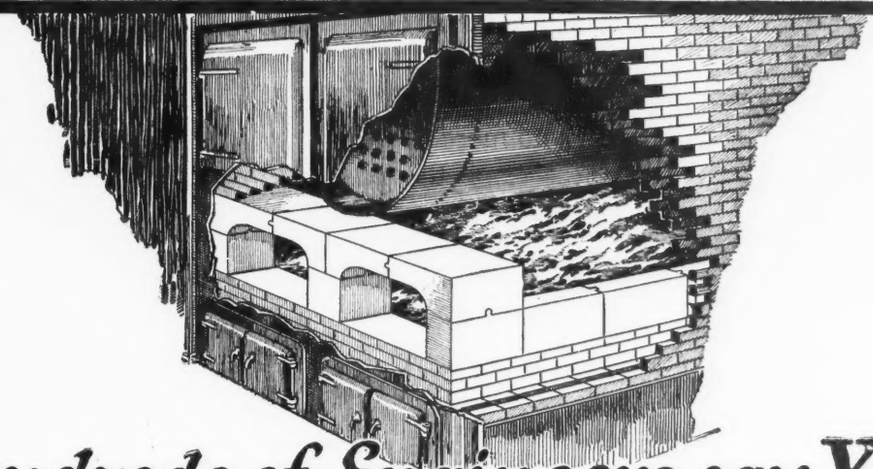
PEABODY
BURNERS *for* ALL FUELS
Peabody Engineering Corp'n, 112 E. 42nd St., New York, N. Y.

CoKal Stokers
are Modern Automatic Coal Burners
COKAL STOKER CORPORATION
1014 WRIGLEY BLDG., CHICAGO.

NEEMES
GRATES AND STOKERS
Shaking and Dumping Types **Hand-Operated**
Send for bulletins
Neemes Foundry, Inc., Troy, N. Y.

"Buffalo" FANS
for mechanical draft heating and ventilating
Buffalo Forge Co.
488 Broadway Buffalo, N.Y.

Can this STEEL MIXTURE BOILER DOOR ARCH *last 15 Years without Repairs?*



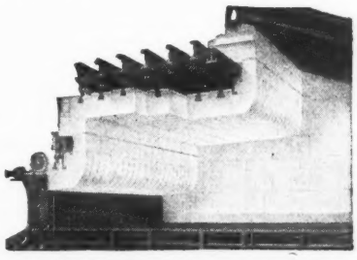
Hundreds of Engineers say YES!!

A few isolated instances of long life in Steel Mixture Refractories would mean very little—

But when you consider that hundreds of engineers in many of the most efficiently operated plants in America have testified that Steel Mixture Furnace Linings and Arches have remained in perfect condition for 5 to 15 years without one cent's worth of repairs—

Then, we think you will agree that we are conservative when we say that "Steel Mixture" usually *lasts from three* to *five times as long* as ordinary refractories.

For example, Charles Stuart, Engineer of the Standard Dyeing Co., Paterson, writes that Steel Mixture is in good condition after 14 years of use in seven of his boilers.



Flat Suspended Furnace Arch

"STEEL MIXTURE" Furnace Linings and Arches

REG. U.S. PAT. OFF.

W. T. Vogel, Comstock, N. Y., wrote that the Steel Mixture Arch over their backoven was as good as ever after 14 years of service. A Steel Mixture Arch, in use 24 hours a day in the Municipal Electric Light Plant, Rainy River, Ont., lasted for 16 years.

We will be glad to send you a booklet giving the names of concerns all over the country who have testified to the unusually long service given by Steel Mixture Refractories.

When Steel Mixture is saving time, money and shut-downs in so many plants, isn't it safe to say that its use will prove equally advantageous to you?

Write for Catalog No. 31, illustrating and describing refractories to meet every condition, or simply mail the coupon for booklets desired.

McLEOD & HENRY CO.

Specialists in Furnace Refractories for More Than 100 Years

31 Monroe St., Troy, N. Y.

Branches: **New York Boston Cleveland Detroit**

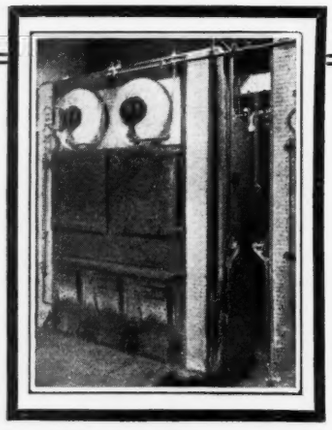
McLEOD & HENRY CO., 31 Monroe St., Troy, N. Y.
Please send me free the booklets checked:

- ☐ Flat Suspended Furnace Arch, Booklet 162-31.
- ☐ Boiler Door Arches and Fire Box Blocks, Booklet 156-31.
- ☐ Veneer Lining for Air-Cooled and Solid Walls, Booklet 161-31.
- ☐ Back Combustion Chamber Arch and Blow-Off Pipe Protectors, Booklet 157-31.
- ☐ Steel Mixture Fire Brick, Booklet 158-31.
- ☐ High Temperature Fire Cement, Booklet 160-31.
- ☐ Carbex (Silicon Carbide) Super-Refractories, Booklet 163-31.

Name .....

Address .....

Town ..... State .....



A 400 hp. B & W boiler installed by Page for Brunswick Laundry, Jersey City, N. J.

Let PAGE estimate on your boiler masonry work

Page asks no more than average prices—and there comparison ends! Page workmanship and knowledge of modern boiler engineering requirements make Page figures very attractive to engineers desiring proper boiler masonry work.

Page has a big organization of skilled and experienced boiler masons handling over 1000 jobs annually.

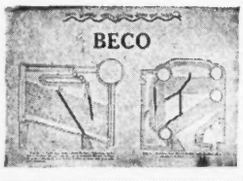
THE FREDERICK PAGE CONTRACTING CO., INC.
45 East 17th St. New York, N. Y.

Boiler Baffle Walls—Boiler Settings—Boiler Furnace Walls—Incinerators

PAGE BAFFLE WALLS
EFFICIENCY DURABILITY

"Quality Service at the Right Price"

THERE IS A
UNIPULVO UNIT PULVERIZER
FOR EVERY BOILER
From One Hundred to One Thousand Horsepower
THE STRONG-SCOTT MFG. CO.
MINNEAPOLIS, MINNESOTA
Agencies in Principal Cities



How To Baffle Boilers
Bulletin "P-2" tells and shows how to baffle water tube boilers. We build the famous Turner Baffle and the more recent BECO Baffle. Engineers estimate that the Turner alone is now saving 405,000 tons of fuel annually. Send sketch for quotation.
Boiler Engineering Co.
931 Federal Trust Bldg., Newark, N.J.

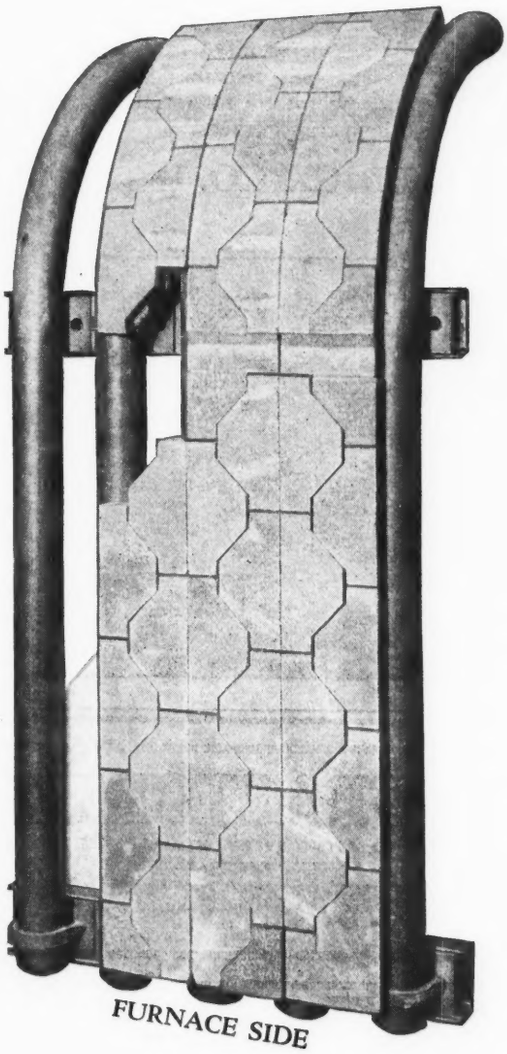
AUBURN *HEAVY DUTY* STOKER
A Full Mechanical overfeed stoker. Natural or Forced Draft; Sizes 150 to 3000 H.P.
Auburn Automatic Fireman
A high class, fully automatic underfeed stoker for low set and internal firebox boilers. Sizes from 20 to 200 H.P.
Auburn Stoker Corp., Auburn, Ind.

With Dampered Air Control
ILLINOIS
CHAIN-GRATE
STOKERS
ILLINOIS STOKER COMPANY
104 West 7th Street Alton, Illinois
Representatives in Principal Cities of U. S. A. and at 900 Bay St., Toronto, Canada
Forced or Natural Draft

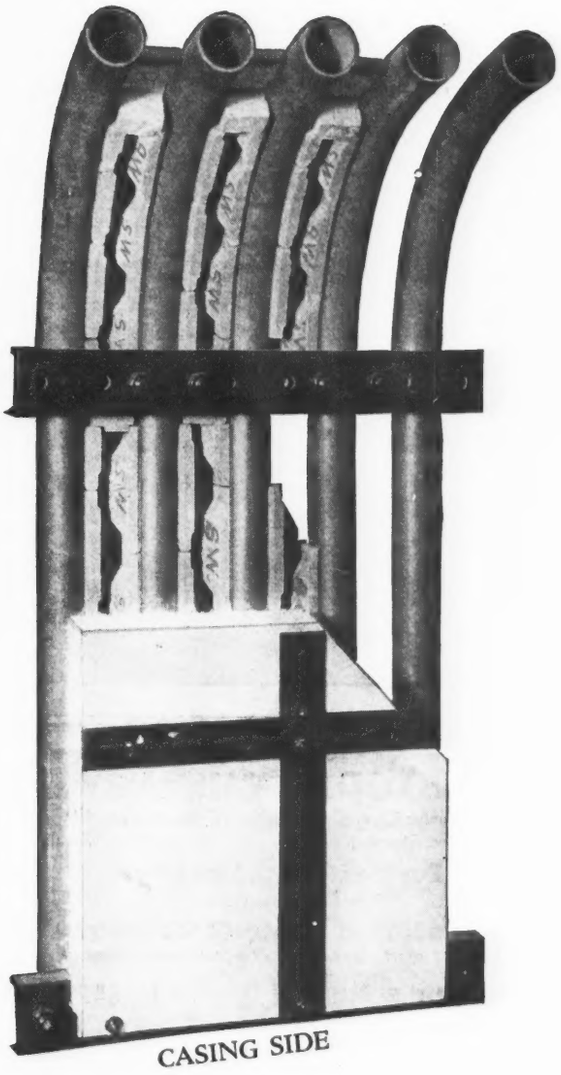
Hammel Oil Burning System
Our engineering department is available for consultation on your oil burning requirements. Write us for Bulletins covering our Oil Burning System, Oil Burners, Oil Heaters, Oil Pump Sets and Accessories
See page advertisement in Nov. 27 issue,
HAMMEL OIL BURNING EQUIPMENT CO.
409 Pine St., Providence, R. I.

COEN
for Increased Steam Production
MECHANICAL OIL BURNERS & IMPROVED AIR REGISTERS
Wide flexibility. Ideal flame control. A 100% load range without changing burner tip. Increased output of any type of boiler. Write for Bulletin "M."
COEN COMPANY, Inc., 50 Church St., New York—112 Market St., San Francisco

Manifest PROGRESS



FURNACE SIDE



CASING SIDE

Bernitz Co.'s "Nygaard Water Wall"

OUTSTANDING FEATURES:

1. Blocks readily replaceable from fire side without dismantling any construction in rear of tubes.
2. Large contact area formed by blocks encircling tubes.
3. Ingenious yet simple interlocking arrangement forces blocks firmly against tubes giving intimate contact.
4. Entire elimination of auxiliary clamping devices.
5. Complete allowance for expansion.
6. Blocks are made of Carbofrax (the Carborundum Refractory) thereby assuring high heat transfer and durability.
7. Protection against tube failures from overheating.
8. Active combustion maintained right up to face of water wall materially aids economy in steam cost.
9. Moderate first cost and maintenance.

BERNITZ FURNACE APPLIANCE COMPANY

Main Office: 89 Broad St., BOSTON, MASS.

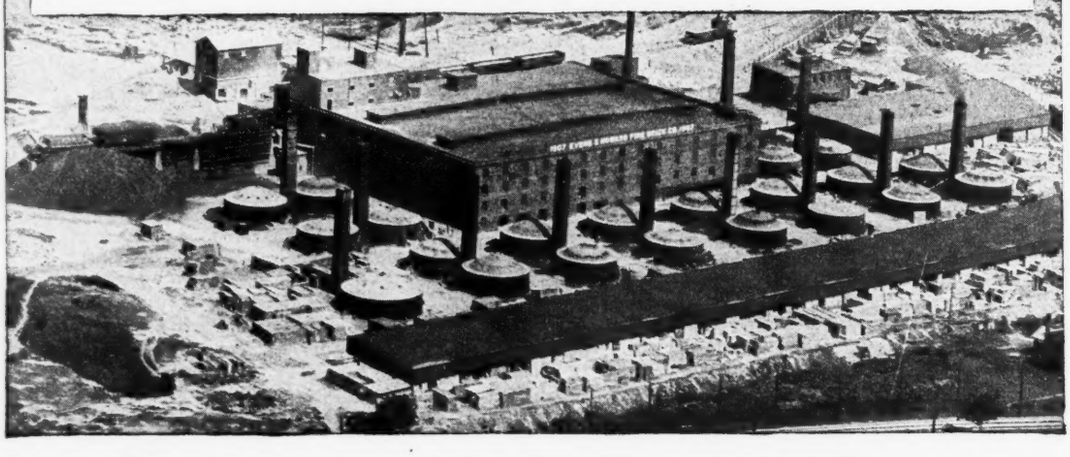
"There is a Bernitz Furnace Lining for every fuel and firing method"

(11328)

FIRE BRICK *that Meet the Exacting Demands of Today!*

MORE than seventy years of specialized experience in the development and manufacture of high grade refractories qualifies us to serve you satisfactorily with fire brick of greatest possible dependability and endurance. We especially recommend to your notice our "Acme" and "St. Louis" brands of fire brick, which are successfully meeting the severe furnace conditions incidental to modern industrial methods.

EVENS & HOWARD FIRE BRICK CO.
SAINT LOUIS, MISSOURI



CUSTODIS CHIMNEYS

Alphons Custodis Chimney Construction Co.
95 Nassau Street, New York Marquette Bldg., Chicago

Perforated Radial Brick Chimneys

Reinforced Concrete Chimneys

Builders of the Tallest and Largest Brick Chimneys in the World

Chimneys of all Sizes for all Purposes for Steam Boilers, Furnaces, Chemical Plants, Destructors, etc. Experts in repairing chimneys. Lightning Rods installed and repaired. Specifications, plans, designs and data furnished free upon request.

Send for free booklet P4 "How to Determine the Proper Size of Chimney" and "A Treatise on Calculation of Stresses in Brick Chimneys."

ATLANTA	MINNEAPOLIS	SEATTLE
BOSTON	PHILADELPHIA	TORONTO
CLEVELAND	PITTSBURGH	MONTREAL
DETROIT	PORTLAND, ORE.	VANCOUVER
DALLAS	RICHMOND	HALIFAX
MILWAUKEE	ST. LOUIS	

REFRACTORIES

TO SATISFY EVERY NEED OF POWER PLANT OPERATORS

HARBISON-WALKER REFRACTORIES CO.
Worlds Largest Producers of Refractories
Pittsburgh, Pa. U.S.A.

Queen's Run Glass

THE UNEXCELLED REFRACTORY FOR BOILER FURNACE LINING!
"LET US SERVE YOU"

QUEEN'S RUN REFRACTORIES CO. INC.
LOCK HAVEN, PA.

THERE are now more than 12,000 installations of **Detrick Arches** and **Detrick Sectional Supported Walls** in satisfactory service. The experience gained in solving this large number of furnace problems is offered to you for the solution of your own.

M. H. Detrick Company
140 S. Dearborn St., Chicago, Ill.

DETRICK ARCHES & WALLS

DURA-STIX

has achieved a dignified reputation for faithful service to industry.

Bonds and *Extends* the life of fire brick in the best known plants of America. *Booklet PH tells how.*

KEYSTONE REFRACTORIES CO., 120 Liberty St., New York

The
RUST ENGINEERING CO.
PITTSBURGH, PA.

CHIMNEYS—Brick and Concrete
Boiler Settings—Power Plants

New York Birmingham Washington

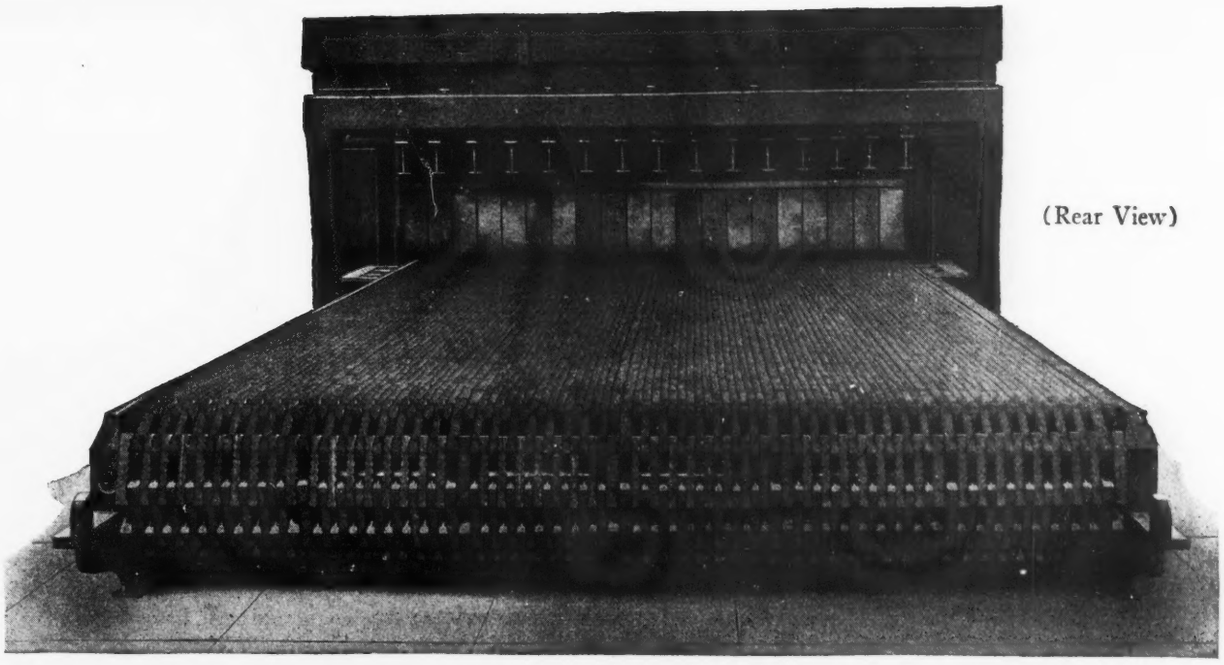
HUBER STOKER

PATENTED

A Stoker for Every Boiler

Write for interesting records of performance in representative plants, and a copy of "Five Minutes With the Coal Bill".

Flynn and Emrich Company
305 N. Holliday Street
Baltimore, Md.



(Rear View)

McCLAVE COMBUSTION SYSTEMS

- Mechanical Stokers (Universal)
- Bituminous Chain Grate Stokers (Forced Draft)
- Bituminous Chain Grate Stokers (Natural Draft)
- Anthracite Chain Grate Stokers (Forced Draft)
- Underfeed Stokers
- Lignite Stokers
- Type "M-A" Stokers
- Low-Pressure Boiler Furnace Grates
- Industrial Furnaces
- Sectional Boiler Fronts
- Boiler Dead Plates
- Argand Blower Regulators
- Low Pressure Water Backs
- Hopper Feed Hand Stokers
- Hand Fired Stokers
- Shaking Grates
- Cut-Off Grates
- Dumping Grates
- Round Grates
- Lignite Grates
- Bagasse Grates
- Stationary Grates
- Incinerator Grates
- Bituminous Magazine Furnaces
- Kiln Furnaces
- Sectional Boiler Fronts
- Wood Burning Furnace Grates
- Argand Forced-Draft Blowers
- High Pressure Water Backs

This MODERN McCLAVE CHAIN GRATE STOKER is designed to burn BITUMINOUS FUEL

If bituminous is your power fuel investigate the records of the McClave Chain Grate Stokers now in service. They have been the means of attaining higher capacities. Invariably they bring about material economies in combustion. The unit may be had in either forced or natural draught types. The new spur gear and racket drives, absolute control of draught within any air compartment, renewable links, mechanical sifting removers and other improvements, are advantages which should not be overlooked.

McCLAVE-BROOKS COMPANY

Sole Makers of McClave Grates Since 1883

SCRANTON, PENNSYLVANIA

District Headquarters in United States

NEW YORK, 1440 Broadway
PHILADELPHIA, 913 Fidelity Phila. Trust Bldg.
PITTSBURGH, 304 Oliver Bldg.
BUFFALO, 333 Jackson Bldg.
CHICAGO, 1630 Conway Bldg.
ATLANTA, 1328 Candler Bldg.
DALLAS, TEXAS, 1204 Santa Fe Bldg.

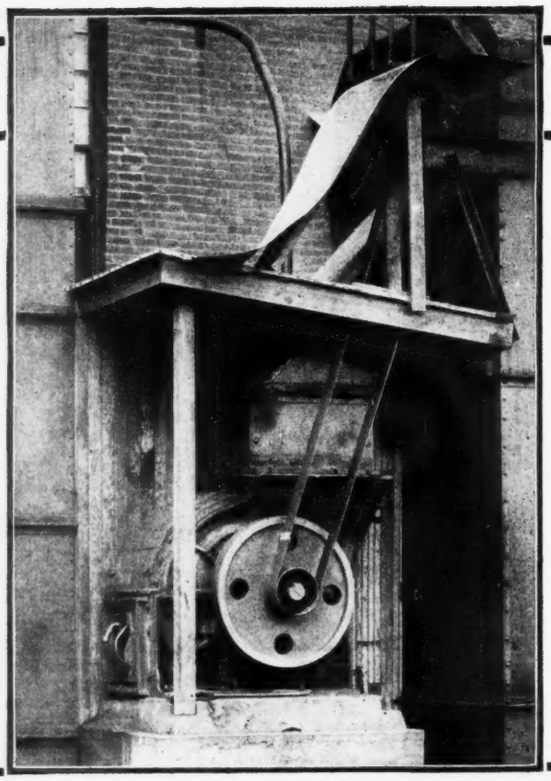
District Headquarters in Canada

ST. CATHERINES, ONTARIO
Moss Engineering Co., Ltd., 1 Queen St.
KITCHENER, ONTARIO
Moss Engineering Co., Ltd., 1 King St., East
MONTREAL, QUEBEC
Moss Engineering Co., Ltd. c/o Heating Equipment Co., Ltd. 1131 Bleury St.
WINDSOR, ONT.
Moss Engineering Co., Ltd. c/o Larkin & Rigney, 30 London St., West
TORONTO, ONT.
Moss Engineering Co., Ltd. 92 Church St.
LONDON, ONT.
Moss Engineering Co., Ltd. c/o Arnoldi Engineering & Mfgrs. Agencies 218 Richmond Bldg.

McClave COMBUSTION SYSTEMS FOR HIGHEST ECONOMY AND EFFICIENCY IN BURNING Anthracite Bituminous Lignite

McClave STOKERS AND GRATES

"FIT THE STOKER TO THE COAL"



No. 24-S American Ring Crusher at the American Diamalt Company, Cincinnati, Ohio. Capacity 60 tons per hour R. O. M. coal to a ¾-in. product.

American Ring Crusher

Meeting every requirement for pulverizing fuel equipment

Due to the exacting demands of pulverized fuel equipment more and more industrial power plants are realizing the advantages of crushing coal at their own power plants.

The advantage of being able to determine the most efficient boiler fuel and the assurance of always getting a fuel exactly suited to your needs justifies the installation. The dependability of American Ring Crushers for maintaining a uniform product at the lowest cost per ton to produce recommends them for this service in both large and small industrial plants.

May we tell you more about the Rolling Ring Crusher principle and construction features of these crushers? Write for surveys and installations in your vicinity.

ORIGINATORS OF THE ROLLING RING CRUSHER PRINCIPLE

AMERICAN PULVERIZER CO

1249 MACKLIND AVE., ST. LOUIS, MISSOURI

AMERICAN *locomotive* CRANES

—Steam
—Gasoline
—Diesel
—Electric

Capacities from ten to forty tons.
Car trucks or Continuous Chain Treads

AMERICAN HOIST & DERRICK CO.

Saint Paul, Minn.

New York . Chicago . Pittsburgh . St. Louis. New Orleans.

HYDROJET

ASH SLUICING SYSTEMS

Cast Iron Ash Hoppers ~ Tanks ~ Coal Bunkers
Water Collecting Ash Gates

ALLEN - SHERMAN - HOFF CO.

227 S. 15TH ST. - PHILADELPHIA

INDUSTRIAL BROWNHOIST

Locomotive Cranes — Clamshell Buckets
Chain Conveyors — Creeper Cranes
Belt Conveyors — Coal Bunkers

Industrial Brownhoist Corporation
Cleveland, Ohio

The Standard for 84 Years

LACLEDE FIRE BRICK

LACLEDE-CHRISTY, ST. LOUIS, U.S.A.

Also use L-C Flat Arches and Arch Tile

H. R. HEINICKE, INC.

Incorporated 1904

Radial Brick Chimneys

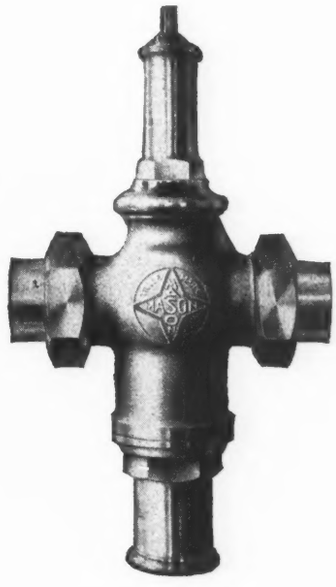
For Every Purpose — Expert Repair Crews
Ask for Bulletin No. 25

New York
342 Madison Ave.

Indianapolis, Ind.
221 So. New Jersey St.

A Partial List of Well-Known Plants and Buildings where Mason Regulators are Installed

Beth Israel Hospital	Boston
Parker House	Boston
Ritz Carlton Hotel	Boston
Massachusetts General Hospital	Boston
Harvard University	Cambridge
Yale University	New Haven
New Convention Hall	Atlantic City
Mattawan Hospital	Mattawan, N. Y.
Rosslyn Hotel	Los Angeles
Insurance Company of North America	Philadelphia
Curtis Publishing Co	Philadelphia
Rockefeller Institute for Medical Research	New York
Cathedral of St. John the Divine,	New York
Metropolitan Life Building	New York
Grand Central Terminal	New York
Graybar Building	New York
Postum Building	New York
Equitable Life Building	New York
New Netherlands Hotel	New York
Salmon Tower Building	New York
General Motors Building	New York
Goodyear Tire and Rubber Co	Akron
Goodrich Tire and Rubber Co	Akron
Procter and Gamble	Cincinnati
Chevrolet Motor Co	Flint
Chrysler Motor Co	Detroit
American Sugar Refining Co.,	Baltimore, Boston, Brooklyn, Philadelphia
National Biscuit Co.	Boston, Detroit, Los Angeles, Philadelphia
Gulf Refining Co.	Fort Worth
Tennessee Coal & Iron R. R. Co.,	Birmingham
Mallory Hat Co.	Danbury
Southern California Edison Co.,	Long Beach
Walter Baker Co., Ltd.	Boston
Gillette Safety Razor Co	Boston
Swift & Co	Boston



Mason Standard
Reducing Valve

Easy to install . . . steady, dependable service, without trouble, without requiring a lot of attention . . . set 'em and forget 'em . . . these are the reasons why Mason Regulators are the choice of experienced engineers for every pressure control purpose. Write for a copy of Catalog No. 62.

Mason Regulators

MASON REGULATOR CO.
Boston, Mass.

San Francisco Office, 606 Howard Street
Mason Regulator Co. of Canada, Ltd., 686 Notre Dame St., West, Montreal

2489

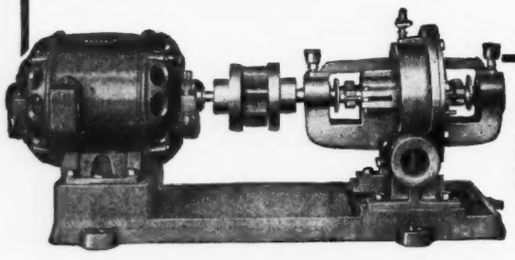
There are Sound Reasons Why Power Plant Engineers *Specify*

WESTCO PUMPS

The ever increasing popularity of WESTCO PUMPS among power plant engineers is not a thing of chance. The fact is, WESTCO PUMPS embody many exclusive features of performance and design which wide experience and application have proven valuable to a pump unit in power plant service.

The following features—all found in WESTCO—combine to give positive assurance of pump satisfaction and unmatched performance under widely varied operating conditions.

- *Wide Operating Range*
- *High Pressures in Single Stage*
- *Only One Moving Part*
- *Efficiency Equal to Piston Pumps for Small Capacities*
- *No Metal to Metal Contacts to Cause Friction or Wear*
- *Perfect Hydraulic Balance*
- *Ball Bearing Construction*
- *Double Suction*
- *Direct Connection at Standard Motor Speeds*
- *Compactness*
- *Accessibility*
- *Silent in Operation*



WESTCO Pump direct connected to electric motor

WESTCO-CHIPPEWA PUMP COMPANY
Factory and General Offices: Davenport, Iowa

Branches:
NEW YORK CHICAGO SAN FRANCISCO

Distributors in Principal Cities

Westco PUMPS

HIGH PRESSURES *in* SINGLE STAGE

Westco-Chippewa Pump Company, Davenport, Iowa
O-1
Gentlemen: Please send me a copy of your Westco Catalog.
Name .....
Address .....
City ..... State .....

KELLOGG

POWER PLANT PIPING—SEPARATORS
FORGE WELDED PIPE—RECEIVERS
FORGE WELDED CONTAINERS

The M. W. KELLOGG CO., 7 DEY ST., N.Y.C.
Boston Chicago San Francisco

All Kellogg Piping Products are insurable

YARWAY
INVOLUTE SPRAY NOZZLE.
Spray Cooling Equipment. Send for Booklet N613.
YARNALL-WARING CO., Mermaid Ave., Phila.

MARLEY SPRAY NOZZLES

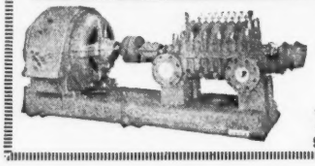
CATALOG ON REQUEST
THE MARLEY CO., Kansas City, Mo.
Formerly the Power Plant Equipment Co.

Air Washers, Cooling Ponds, Air Filters
Self-Cleaning Strainers
Nozzles of all kinds
Send for Bulletin C-27

SPRAY ENGINEERING CO.
60 High Street, BOSTON, MASS
See advertisement in Dec. 18

TRADE MARK
SPRACO
BOSTON

CENTRIFUGAL PUMPS



BOILER FEED
WATERWORKS
CIRCULATING
GENERAL SERVICE
Pumps for Every Condition
LECOURTENAY CO.
9 MAINE ST., NEWARK, N. J.

Quality from first to last makes
"Pneumo-Gravity" unsurpassed

BITUMINOUS VICTOR COAL

Anthracite

PEALE, PEACOCK & KERR
No. American Bldg., Philadelphia
Graybar Bldg., New York

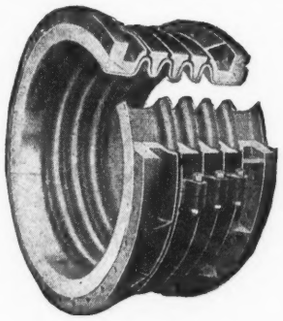
PITTSBURGH COAL CO
CHAMPION STEAM COAL
PITTSBURGH, PA

CLEAN – UNIFORM – WELL PREPARED
AND SIZED TO MEET YOUR REQUIREMENTS
PITTSBURGH COAL CO., PITTSBURGH, PA.

BADGER Self-Equalizing Expansion Joints, welding type, welded directly into an underground main, thereby eliminating flanged joints. The pipe alignment is maintained by the standard Badger pipe guides, which are shown in place, ready for anchoring in concrete piers. These standard guides are likewise suitable as anchors, by welding lugs to the pipe on each side of the guide straps.

Freely take up expansion in underground mains—

Badger Self-Equalizing Expansion Joints will permit the pipe line to move freely by the flexibility of the one piece deeply corrugated copper expansion element, which takes the place of the usual sliding joint. External equalizing rings distribute the movement uniformly over all the corrugations and prevent excessive wear. When the pipe is properly anchored and guided—these expansion elements will last for years without attention. No packing and no maintenance is required. Guaranteed to 200 lb. working steam pressure.



Badger Self-Equalizing Expansion Joint, flanged type for saturated steam. For superheated steam service, the joint is provided with a Monel metal telescoping sleeve, inside of the copper corrugations.

Badger Self-Equalizing Expansion Joints in either the welding or flanged types are furnished in single or double units. The latter may be provided with service outlet and may be mounted on a structural steel frame on which they are anchored and guided—ready for installation at a large saving in labor cost.

Badger Engineering Service

Badger engineers are designers, manufacturers and installation experts for the following and kindred power plant products: Pipe Bends, Chemical Apparatus, Copper and Sheet Metal Work, Copper Boilers.

E. B. Badger & Sons Co.

75 Pitts St. **Boston, Mass.**

New York, 271 Madison Ave. **Chicago, 2831 South Parkway**

Representatives in all principal cities.

BADGER EXPANSION JOINTS

ESTABLISHED 1841 · WEATHER VANE ON FANEUIL HALL · E. B. BADGER & SONS COMPANY · TRADE MARK

INJECTORS

are built for years of service

Double tube design permits handling hot water at high suction and with low steam pressure against high back pressure.

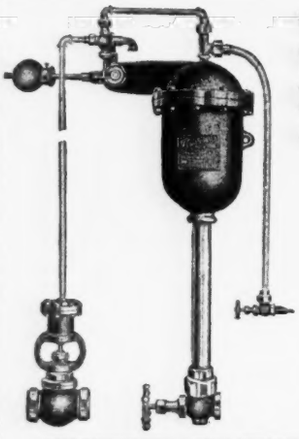
16 standard sizes — ¼" to 3"

New edition of Bulletin 1-A is ready

SCHUTTE KOERTING

1150 Thompson St., Philadelphia, Pa.

See our ads on pages 72 and 74



Why Put Up With Out-of-Date Hand Regulation of Boiler Feed?

You can never hope to attain maximum economy and efficiency with it. Between high water and low water your profits will continue dribbling away.

VIGILANT
Feed Water Regulators

Provide automatic mechanical regulation that can be depended upon to keep the water level at middle gauge. They hold the water level at a fixed point, under all operating conditions and at all boiler loads.

They require no attention. Their operation depends upon gravity and NOT upon expansion tubes, floats or diaphragms. The money saved pays the cost of a good regulator many times over.

Ask for catalog and details about our Trial Offer.

The Chaplin-Fulton Mfg. Co.

28-40 Penn Ave., Pittsburgh, Penna.

Also Manufacturers of the Fulton Pump Governor

"Frederick Features"

SPECIALIZED

In this age of specialization, it is significant that the best machinery, too, is designed for an *especial condition*—as with a Frederick Pump.

Whether for Boiler Feed, Water Lines, Sanitary Lines, Cooling, Fire Protection, or Oil—Frederick Centrifugal Pumps are "Engineered Pumps," built to suit operating requirements. They also are specialized and designed by Pump Specialists.

Our Engineering Service is valuable to you, yet may be had purely "For the Asking."

FREDERICK PUMPS

THE FREDERICK IRON & STEEL CO. FREDERICK, MD.

RoTURBo CENTRIFUGAL

PUMPS

Manistee Iron Works Co., Manistee, Michigan

USED BY MILLS MAKING OVER 80% OF THE COUNTRY'S PAPER

VACUUM PUMPS

Nash Hytor

AIR COMPRESSORS

NASH ENGINEERING CO. SOUTH NORWALK, CONN.

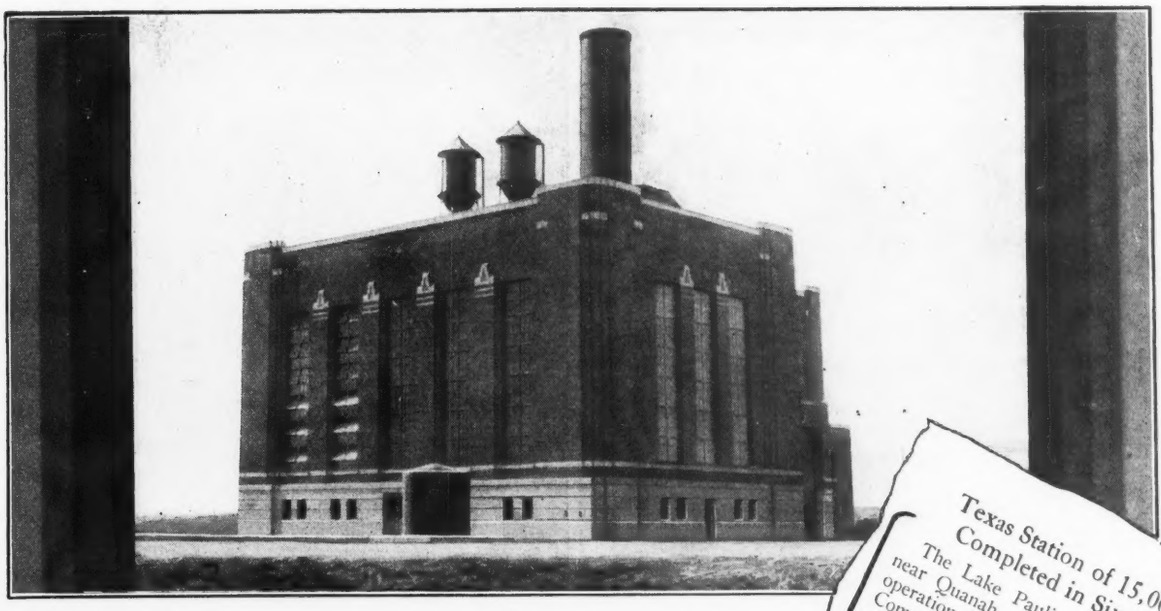
Surface Condensers, Jet Condensers, Barometric Condensers, Leach Fracto Control Condensers, Oil Vapor Condensers for High Vacuum Distillation, Heat Exchangers, Sand Separators, Radojet Air Pumps for vacua up to 29.95 inches, Forced and Natural Draft Cooling Towers.

C. H. WHEELER MANUFACTURING COMPANY

19th St., Lehigh and Sedgley Aves. Philadelphia, Pa.

C. H. WHEELER & PHILADELPHIA

A New RECORD
in power plant construction



MIDWEST *helped establish it!*

This record is a credit not only to the West Texas Utilities Company, and to Sargent & Lundy who were the engineers — but also to the equipment manufacturers and contractors on the job.

The piping was fabricated by the Midwest Piping & Supply Co.; it was erected by the Urbauer-Atwood Co. which has since been consolidated with Midwest. The parts that these companies had in the Lake Pauline achievement are but an indication of the capabilities—both in the shop and in the field—of the combined organizations.

Whether you require complete piping for a power plant or industrial process—or only a simple pipe bend, coil or welded header—the Midwest Piping Service is well qualified to supply your needs. Get in touch with the nearest office.

Texas Station of 15,000-kw Completed in Six Months

The Lake Pauline generating station near Quanah, Texas, has been put into operation by the West Texas Utilities Company just six months after ground was broken and construction began. This is considered as a time record in engineering circles, inasmuch as the 200 workmen employed on the job labored only during daylight and without requiring overtime.

The station has a capacity of 15,000 kw.; it generates at 13,200 volts and transmits at 66,000 volts; and is equipped with a General Electric turbine and three 10,000-sq. ft. Stirling boilers. The turbine is of the latest design and will operate on 375-lb. steam pressure and a steam temperature of 684 deg. The boilers are designed to operate at 300 per cent rating.

Oil and gas will be used for fuel, all equipment having been purchased with this in view. It can be converted to the use of pulverized coal should such a change become necessary.

POWER — *October 9, 1928*

MIDWEST PIPING & SUPPLY CO., INC.

Plants at St. Louis and Los Angeles

OFFICES

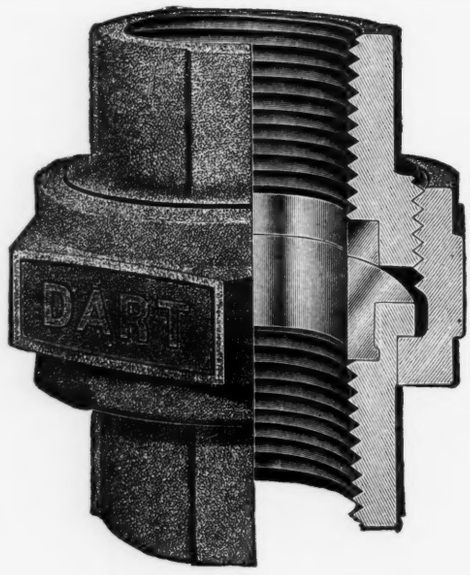
ST. LOUIS, 1450 S. Second St.
CHICAGO, 208 S. LaSalle St.

MIDWEST

OFFICES

TULSA, 805 Mayo Building
LOS ANGELES, 520 Anderson St.

PIPING SERVICE



1 = 2

One Dart Union will last as long as two ordinary unions. Unions last no longer than their seats. Dart Unions last twice as long as others because of the two bronze-to-bronze seats, which make up easily to a permanently tight, corrosion-proof joint.

Why buy two unions when one Dart Union will last as long as both?

Every DART Union is guaranteed. We will replace any Dart Union proving defective in material or workmanship with two perfect Dart Unions without charge.

Try a Dart at our expense. Send in the coupon for a free sample.

E. M. Dart Mfg. Co.

Providence, R. I.

Sales Agents: The Fairbanks Company, New York and at all branches

Canadian Factory: Dart Union Company, Ltd., Toronto, Canada

E. M. Dart Mfg. Co., Providence, R. I.

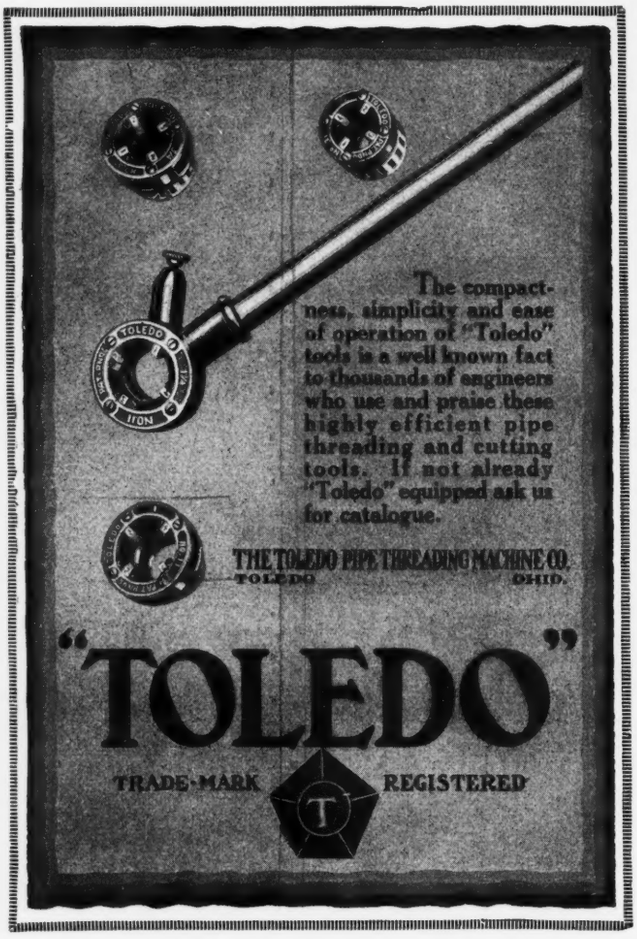
Without charge or obligation, send 32-page illustrated catalogue and sample Dart union to try.

Company .....

Individual .....

Address .....

City ..... State.....



The compactness, simplicity and ease of operation of "Toledo" tools is a well known fact to thousands of engineers who use and praise these highly efficient pipe threading and cutting tools. If not already "Toledo" equipped ask us for catalogue.

THE TOLEDO PIPE THREADING MACHINE CO.
TOLEDO OHIO.

"TOLEDO"

TRADE-MARK REGISTERED

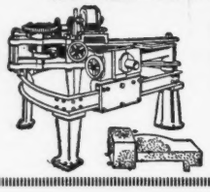
"WONDER" COLD PIPE, TUBING AND BAR BENDERS

Standard of the World

HAND AND MOTOR OPERATED

14 Sizes of Machines

What it costs to bend pipe our way. Per Bend:
1-in. pipe, 5 cents 4-in. pipe, 25 cents
2-in. pipe, 10 cents 6-in. pipe, 60 cents
8-in. pipe, $1.00.



Send for Catalogue

American Pipe Bending Machine Co.
120 Pearl St., Boston, Mass.

Complete piping service

write! **PowerPiping**

POWER PIPING CO., Pittsburgh, Pa.

Engineering experience and plant facilities are the cornerstone of service in pipe fabricating. In both these particulars Grinnell is pre-eminent.

Address inquiries to Providence, R. I.

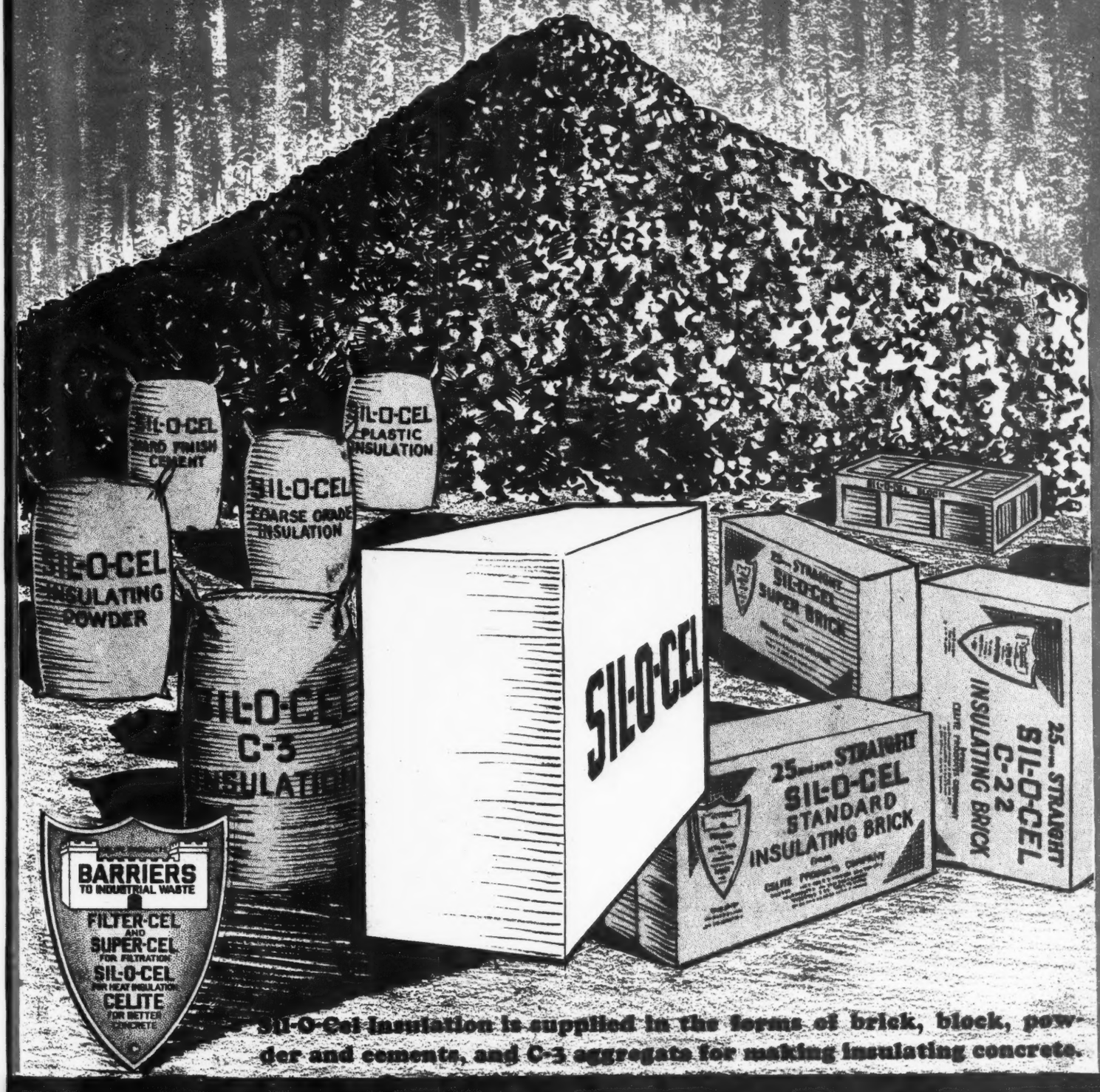
GRINNELL COMPANY

NAVCO **National** NAVCO

POWER PIPING

National Valve and Manufacturing Co.
3101 Liberty Ave. - Pittsburgh, Pa.

GUARDIANS of the FUEL PILE



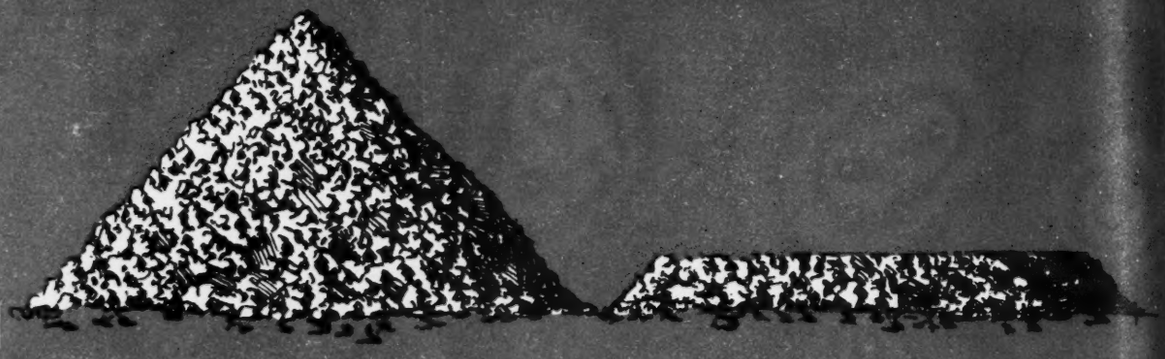
Sil-O-Cel Insulation is supplied in the forms of brick, block, powder and cements, and C-3 aggregate for making insulating concrete.

SIL-O-CEL

HEAT INSULATION

?? WHICH TOLL DO YOU PAY TO HEAT RADIATION

SIL-O-CEL INSULATING BRICK ARE ORDINARILY INSTALLED BETWEEN THE FIREBRICK AND THE RED BRICK OR STEEL SHELL OF A BOILER SETTING.



Heat radiation waste from an un-insulated boiler setting ordinarily amounts to 250 tons of coal lost annually through every thousand square feet of surface.

Sil-O-Cel insulation reduces radiation waste more than sixty per cent. The value of the coal it saves in one year more than repays all the costs of insulating in the average power plant.

Radiation losses, because they are invisible, are often overlooked. Almost invariably they are under-estimated. The average power plant owner, we find, does not realize that 3 to 8 per cent of the fuel he burns leaks out through the walls of his boilers and settings.

If Your Boiler Walls Are Not Insulated You Are Paying Needless Tribute to Heat Radiation.

SIL-O-CEL

CELITE PRODUCTS
BARRIERS
TO INDUSTRIAL WASTE
FILTER-CEL
AND
SUPER-CEL
FOR FILTRATION
SIL-O-CEL
FOR HEAT INSULATION
CELITE
FOR BETTER
CONCRETE

SIL-O-CEL INSULATING SERVICE provides a form of insulating material to fit every kind of structural need, a type to meet every range of temperature requirements. Sil-O-Cel insulating recommendations for all types and sizes of boilers take into consideration installation expense as well as cost of materials used. They are reliable guides to economical insulated construction.

Fill out and mail the coupon for specific data on the insulation of your boilers

CELITE PRODUCTS COMPANY

11 Broadway, New York
225 E. Superior St., Chicago
1320 So. Hope St., Los Angeles
(*please address nearest office*)

Gentlemen: Please send me your recommendations for insulating the following boiler plant equipment.
K-584

Name _____

Address _____

City and State _____

CELITE PRODUCTS COMPANY

11 Broadway, NEW YORK
225 E. Superior St. CHICAGO
1320 S. Hope St. LOS ANGELES

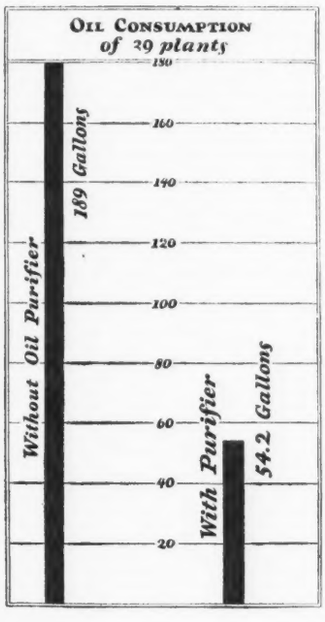
Offices and Warehouses in Principal Cities

Celite Products Limited, New Birks Bldg., Montreal, Quebec
Celite Products Corporation, Windsor House, Westminster, London

Oil why should it be wasted?

IF you don't have oil clarification systems in your steam turbine plant, you are annually wasting 134.8 gallons of oil per each 1000 k. w. of installed capacity.

Power's recent survey proves this fact conclusively. Power reports that 32 steam turbine plants, using oil clarification systems, averaged to use 54.2 gallons of oil per year per 1000 k.w. installed capacity. 7 plants *not* using oil clarification systems, had an average yearly consumption of 189 gallons each per 1000 k.w. installed capacity.



It is self-evident that those steam plants using oil clarification systems consumed less than one-third as much oil as those not using such systems.

Bowser builds oil filters that will enable you to cut down *your* oil consumption. In addition, you would maintain the lubricating value of the oil and give adequate stream feed lubrication. This would eliminate shut-downs, overheated bearings, etc., and make your machinery last longer. We would be pleased to send you the full facts and to show you how Bowser equipment can serve you. The coupon will bring you the facts—mail it today.

S.F. BOWSER & COMPANY, Inc.

COMPLETE LUBRICATION EQUIPMENT

1317 Creighton Avenue

FORT WAYNE · · INDIANA

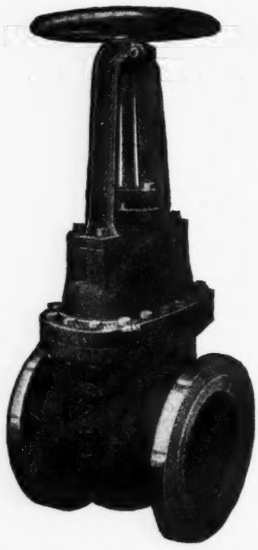
S. F. BOWSER & CO., Inc. BOWSER ESTABLISHED 1885 1317 Creighton Ave., Fort Wayne, Ind.

More information would be appreciated.

*Name*_____ *Address*_____

VALVES
PIPE FITTINGS
FIRE HYDRANTS

KENNEDY



Kennedy Extra Heavy Iron Body Gate Valve for 250 pounds working steam pressure. Furnished with stationary stem or outside rising stem and yoke, and with screwed or flanged ends. One of the many Kennedy types for power plant service.

THERE'S a large factor of safety built into each Kennedy product. Besides designing for strength to withstand exceptional service conditions, every Kennedy Valve is tested to far more than the pressure for which it is guaranteed before being permitted to leave the factory. This is one of the many reasons why Kennedy Valves stand up in services that cause failure of other types, and why so many Kennedy Valves are still in use after a quarter century or more of service.

Send for the Kennedy Catalog

THE KENNEDY VALVE MFG. CO.
Elmira, New York

WAREHOUSES: New York, 128-132 White Street; Chicago, 1335-1337 S. Clinton Street; San Francisco, 448-450 Tenth Street.

SALES OFFICES: New York, Boston, Philadelphia, Cleveland, Chicago, Atlanta, Salt Lake City, El Paso, Los Angeles, San Francisco, Seattle.

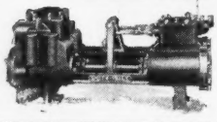
Pittsburgh Piping & Equipment Co.
Pittsburgh, Pa.

1903 — WHEN YOU THINK OF PIPING THINK OF PITTSBURGH PIPING — PP&EC — 1928

TWENTY-FIVE YEARS EXPERIENCE SUPPLYING FABRICATED MATERIALS AND INSTALLING COMPLETE PIPING SYSTEMS.

New York 220 Broadway · Chicago Peoples Gas Bldg. · San Francisco Russ Bldg. · Cleveland Ulmer Bldg. · Detroit General Motors Bldg.
Houghton, Mich. Dee Bldg. · Indianapolis Traction Terminal Bldg. · Boston 10 High St. · Dallas, Texas Am. Ex. Bk. Bldg.
Los Angeles—Bartlett Bldg.

PLATT IRON WORKS – DAYTON, OHIO.
Smith-Vaile PLATT Pumps



Steam and Power Pumping Machinery

PIPING by
R. H. BAKER COMPANY
INCORPORATED
GENERAL MOTORS BLDG. DETROIT · CAMBRIDGE, MASS. · 101 PARK AVENUE NEW YORK
CONTRACTORS FOR STEAM POWER AND INDUSTRIAL PIPING

POWER PIPING
ATWOOD
PITTSBURGH VALVE, FOUNDRY & CONSTRUCTION CO.
PITTSBURGH, PA.

One-Fifth The Weight of Cast Iron Pipe

One-Third The Weight of Wrought Pipe

AN ABSOLUTELY TIGHT DURABLE PIPE

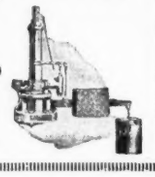
The lap riveted seam repeats its cycle every twelve inches, forming a broad stiffening rib of great value, and makes Root Pipe one-third stronger than any other type of pipe construction. Light weight and simple connections reduce transportation, handling and erection costs. Extensively used for Atmospheric Exhaust, Suction and Discharge Water Lines, Cooling Pond, Powdered Coal, Exhaust Steam and large air lines. ABENDROTH & ROOT MFG. CO. Pipe Specialists Continuously Since 1867. Sales Office: Woolworth Bldg., N. Y.

VALVES AND ENGINEERING APPLIANCES
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO BOSTON PHILADELPHIA
PITTSBURGH SAN FRANCISCO NEW ORLEANS
LONDON
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

Regulating Valves for Every Service

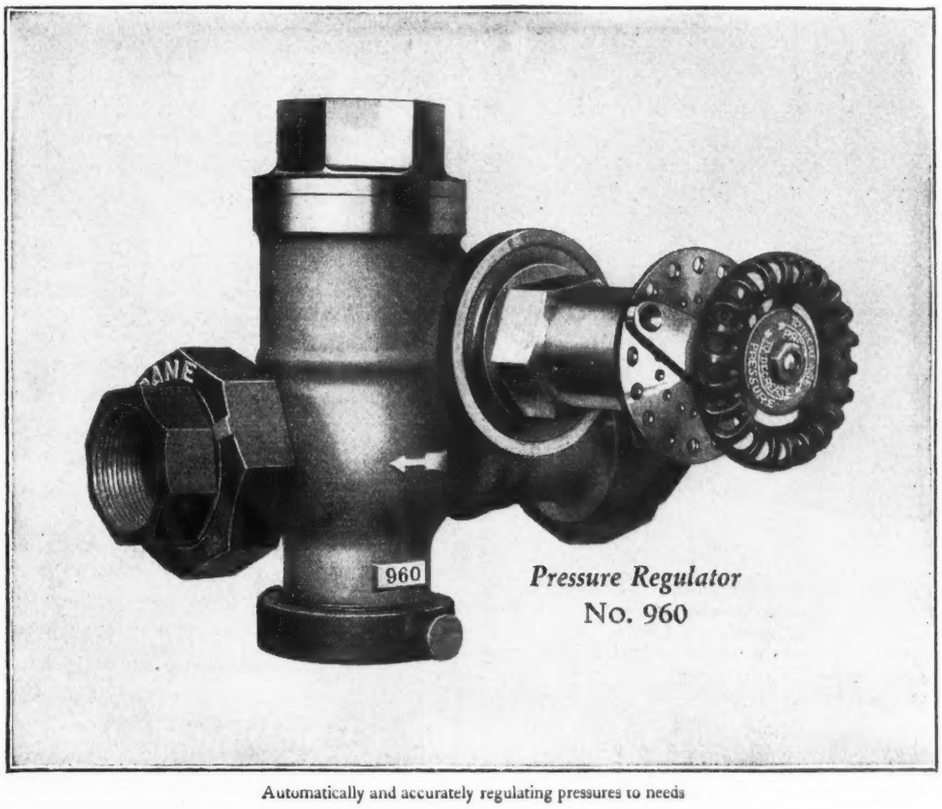
On Which Do You Want Information?

- ☐ Feed Water Regulators
- ☐ Reducing Valves
- ☐ Damper Regulators
- ☐ Temperature Regulators
- ☐ Pump Governors
- ☐ Float Valves
- ☐ Swing Joint Fittings
- ☐ Bronze Unions
- ☐ Thermostats
- ☐ Balanced Valves



Atlas Valve Co., 289 South St., Newark, N. J

150 Pounds Pressure CRANE VALVES 2500 Pounds Pressure



Pressure Regulator
No. 960

Automatically and accurately regulating pressures to needs

Putting the Power-Giant on light duty

Increasingly gigantic power forces, generated in the boiler room, have been found necessary for many processes in present-day manufacturing. Nevertheless, the lighter jobs remain, in which full use of high pressures is both wasteful and destructive.

To bottle up initial pressures, and to release exactly as much as is needed in the service lines, is the work efficiently and automatically performed by Crane pressure regulators for steam or air.

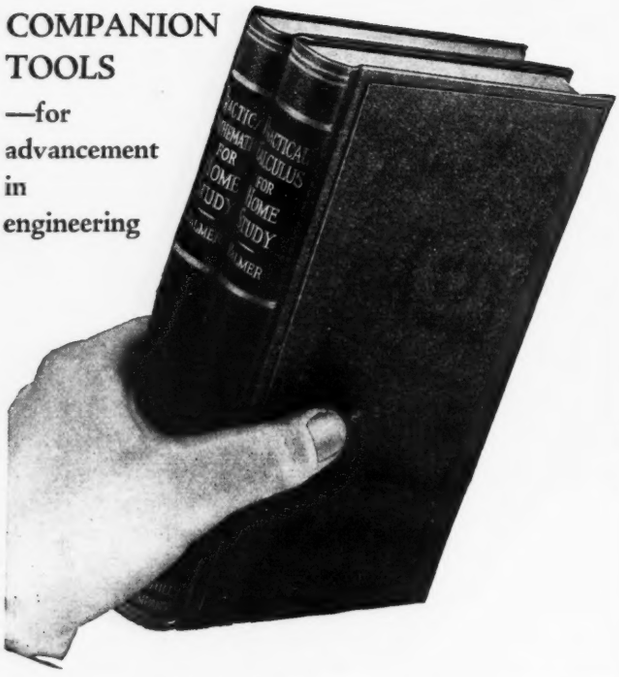
In operation, they are simple. All that is needed is to set the hand wheel at the proper point and lock into place. In service, they are constant. Sensitive as a human nerve, the diaphragm feels the slightest pressure drop on the service side and sends the impulse back to increase the incoming flow.

For full explanation of the principle, installation, and operation, ask for Folder A. D.-11. For information on other Crane steam specialties, as carefully planned and engineered, meeting needs as vital, consult the nearby Crane branch or write to the general offices.

CRANE

GENERAL OFFICES: CRANE BUILDING, 836 S. MICHIGAN AVENUE, CHICAGO
NEW YORK OFFICE: 23 W. 44TH STREET
Branches and Sales Offices in One Hundred and Seventy Cities
National Exhibit Rooms: Chicago, New York, Atlantic City, San Francisco, and Montreal
Works: Chicago, Bridgeport, Birmingham, Chattanooga, Trenton; Montreal, and St. Johns, Quebec; Ipswich, England
CRANE EXPORT CORPORATION: NEW YORK, SAN FRANCISCO, MEXICO CITY, HAVANA
CRANE LIMITED: CRANE BUILDING, 1170 BEAVER HALL SQUARE, MONTREAL
CRANE-BENNETT, LTD., LONDON
CIE CRANE: PARIS, BRUSSELS

COMPANION TOOLS —for advancement in engineering



HERE are two books which cover Mathematics thoroughly from simple arithmetic through calculus. They were written especially for home-study work. Every point is made clear; every step completely explained. Principles are repeated over and over, applied again and again. These books give you the mathematical training and knowledge requisite for every kind of engineering work.

PRACTICAL MATHEMATICS FOR HOME STUDY

By C. I. PALMER

Associate Professor of Mathematics, Armour Institute of Technology.

The essential principles of arithmetic, geometry, algebra and trigonometry are here presented in the form best adapted to immediate and practical use. There are more than 3000 drill exercises and problems designed to clarify and instill the subject matter contained in this thorough book.

493 pages, pocket size, flexible, 229 illustrations, $4.00

Practical Calculus for Home Study

By C. I. PALMER

Most of the new engineering literature makes use of calculus. If a man has no practical grasp of it, he is locked out. This book gives a simple and practical explanation of calculus, shows the engineer where it may be applied to his daily work and tells him how.

443 pages, pocket size, flexible, 186 illustrations, $3.00

See them—Free

McGRAW-HILL
FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc., 370 Seventh Avenue, New York.

Send me for ten days' Free Examination the books checked:
☐ Palmer's PRACTICAL MATHEMATICS, $4.00.
☐ Palmer's PRACTICAL CALCULUS, $3.00.
I agree to send my remittance in ten days or to return the books, postpaid, at that time.

Name .....

Home Address .....

City and State .....

Name of Company .....

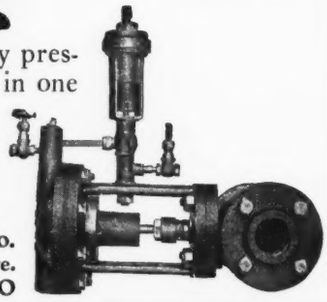
Occupation .....

(Books sent on approval to retail purchasers in U. S. and Canada only.)

P. 12-25-28

Squires Reducing Valve

Will reduce from any pressure to any pressure in one reduction. It is also a dead end valve. *May we send Catalog A-10?*



The C. E. Squires Co.
E. 40th St. and Kelley Ave.
CLEVELAND, OHIO

Morehead Back to Boiler SYSTEM

Provides dependable steam circulation

MOREHEAD MANUFACTURING CO.
Dept. P DETROIT, MICHIGAN

(341)

Three and Four-Way Valves *for* **Air—Steam—Water**

Flat disc type for operating cylinders on all types of equipment.

W. H. Nicholson & Company
125 Oregon Street, Wilkes-Barre, Pa.

WILLIAMS VALVES

REVERSO and IREVERSO Valves, VULCODISC Valves, Bronze Gate and Regrinding Valves and Steam Specialties. Write for bulletins today.

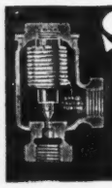
THE D. T. WILLIAMS VALVE CO.
CINCINNATI, OHIO

DEXTER
Valve Reseating Machines

for Globe Valves—for Gate Valves—for Pump Valves

See the full page ad in the issue of Dec. 18
Write for Catalog No. 23

THE LEAVITT MACHINE COMPANY
10 East River St., Orange, Mass., U. S. A.



SARCO STEAM TRAP

Is self-adjusting at pressures from 0 to 100 lbs. Screws right into pipe line. Only one moving part. Costs about one-third the price of bucket or float traps. *Sold on 30 days' free trial. Booklet A-269 on request.*

SARCO CO., Inc., 183 Madison Ave., New York City

SIMPLEX METERS

Measure Boiler Feed, Condensate Make-up, etc.

Simple in construction. Accurate over a wide range with provision to check their operation and adjustment while in service.

Interesting Data on Request.

SIMPLEX VALVE & METER CO.
6747 Upland St., Philadelphia, Pa.

BRISTOL'S
REG. U. S. PAT. OFFICE.
Recording Instruments

for pressure, vacuum, draft, temperature, electrical units, liquid level, speed, and other factors. **Write for Bulletin 1007-G.**

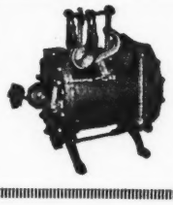
THE BRISTOL COMPANY, Waterbury, Conn.

Trerice Steam Trap

Propeller on bucket rotates at every discharge, turning valve on seat, forming a regrinding valve and seat.

Territory open for good agents. Consigned stocks.

H. O. TRERICE CO.
1338 W. Lafayette Blvd., Detroit



STERLING TRAPS

Return Traps - Lifting Traps
Vacuum Traps - Separating Traps

Sterling Engineering & Manufacturing Corp.
(Templeton Mfg. Co.) 119 Business Street, Boston, Mass.

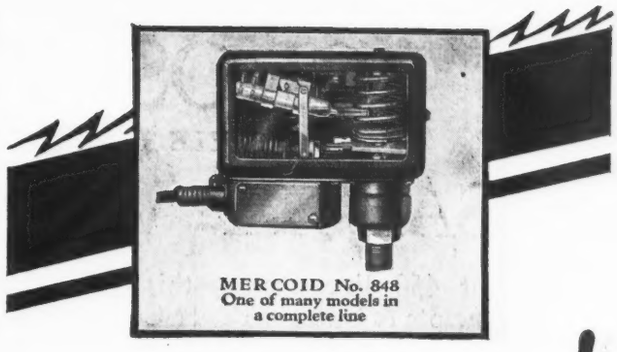
BOILER FEED TRAPS
TEMPLETON
STEAM TRAP CO., Inc. PUMPING TRAPS
77 Cortlandt St., New York
WRITE FOR CATALOG
Agents Wanted—Exclusive Territory

ELLIS STEAM TRAPS ~ TILTING AND BUCKET TYPES ~

There is nothing to equal their simple and reliable operation

ELLIS DRIER CO. 1225 SO. TALMAN AVE. CHICAGO, ILL.

GENUINE NASON STEAM TRAPS
KEEP UPKEEP DOWN
NASON
NASON MANUFACTURING CO. 71 FULTON ST. NEW YORK CITY
Steam Specialty Specialists Since 1841



MERCOID No. 848
One of many models in a complete line

Increase Efficiency!

Prevent Waste

These modern instruments point the way!

JUST suppose you could afford to hire men who would do nothing else but eliminate waste in your processes, heating equipment, power plant, etc. And suppose these men cost you but a small initial investment and drew no salaries. Wouldn't you jump at a chance to get them?

Yet Mercoid Automatic Controls are doing just these things for hundreds of manufacturers. These amazing control mechanisms are almost human. With no attention whatever, they effect savings in steam and current consumption. They save labor and prevent product losses (often extremely costly) due to poorly controlled processes.

Mercoid Controls operate electrically, carrying full line current 110 or 220 volts—an entirely new principle of temperature, pressure and vacuum control. Mercoid success is well established and the following general list shows the almost unlimited range of application.

To start and stop: Motors, Fans, Blowers, Pumps, Compressors.

Unit Heater Control.

Control of electrically heated: Liquids, water heaters, ovens, dryers, pots, forming dies, embossing dies, rolls, drying plates, sterilizers, paraffin tanks, sealing and wrapping machines.

Electrically driven pumps: For pressure, for vacuum, for temperature, for liquid level control.

Liquid level control by pressure or by float.

Bearing Thermostats: For alarm only, for stopping unit, for both.

To sound alarm from: Temperature, pressure, vacuum.

Refrigeration control: For air temperature, for brine temperature, for cooled liquids or gases of all kinds.

Liquids heated by steam or hot water such as: Water heaters, vats, stills, cookers, washers.

Processes cooled by flow of: Water, brine.

Work room temperature control.

Office temperature control.

Steam driven pumps from: Temperature, pressure, vacuum.

Dryers heated by steam or hot water: Dry kilns, dry rooms, ovens, proofing boxes.

Gas heated: Liquids, pots, kettles, ovens, dryers, cookers.

Mail coupon today for free booklet containing blue prints of over thirty different Mercoid applications with hook-ups shown in detail.

When attending the N. Y. Power Show be sure to see Mercoid Controls in operation at the American Radiator Co. Booth.

AMERICAN RADIATOR COMPANY

ACCESSORIES DIVISION, DEPT. M-2612
40 West 40th Street New York, N. Y.

Please send me free booklet containing blue prints of over 30 different Mercoid applications.

Name _____

Address _____

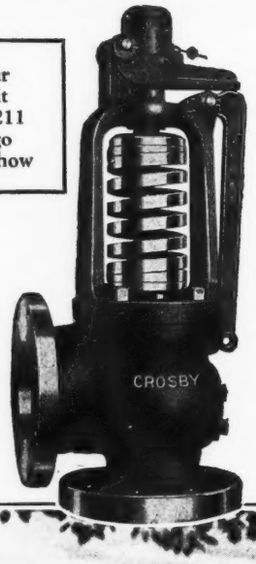
City _____ State _____

CROSBY

NOZZLE TYPE

SAFETY VALVES

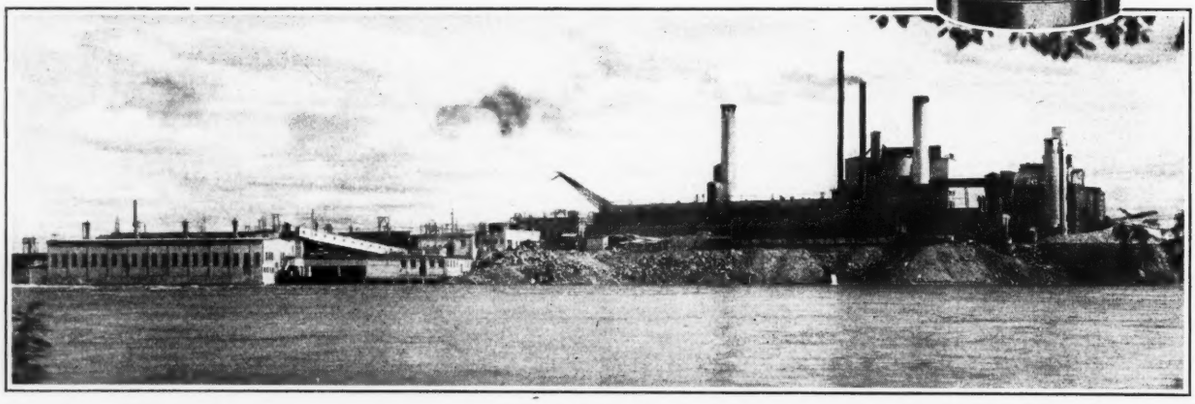
See our Exhibit Booth 211 Chicago Power Show



set at 450 lbs. protect this modern plant of the Minnesota & Ontario Paper Company at International Falls, Minn. One of the many leading industrial plants that have standardized on Crosby Safety Valves.

Crosby Steam Gage & Valve Co., Boston, Mass.

NEW YORK CHICAGO LONDON

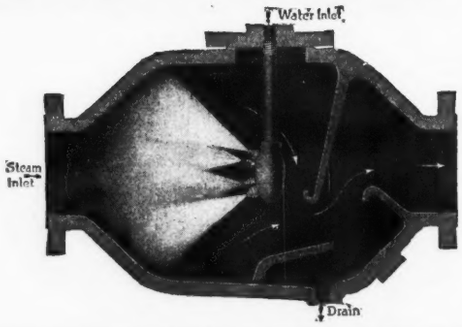


DESUPERHEATERS

for power auxiliaries and process equipment that are not suitable for superheated steam

Spray and surface absorption types.
High or low pressures. Hand or automatic control.

Bulletin 6-D gives complete information

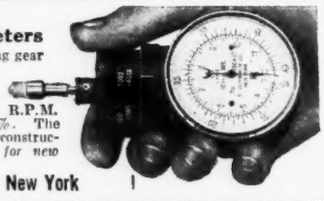


SCHUTTE KÖRTING 1150 Thompson Street, PHILADELPHIA, PA.

See our ads on pages 62 and 74

O-Z Improved Hand Tachometers

Do away with the troublesome sliding gear shift; ball-bearing, dust-proof, fool-proof, large dial, greatly reduced over all length. Five ranges on one spindle, for speeds from 20-40,000 R.P.M. Dead-beat, accurate within ½ of 1%. The only real improvement in tachometer construction in the last 20 years. *Write for new catalog.*



O. Zernickow Co., 21 Park Row, New York

AMERICAN

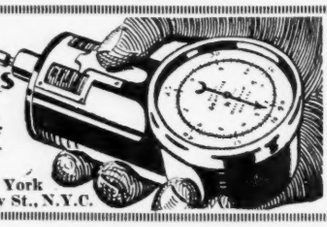
INDICATING PRESSURE GAUGES

for pressure, vacuum and draft. Have extra heavy, long wearing, non-corrosive movement. Dial is hand calibrated, insuring accuracy. White enameled matt finish eliminates glare and makes reading easy. Write for Catalog A-32.

Consolidated Ashcroft Hancock Co., Inc.
American Schaeffer & Budenberg Division
338 Berry St., Brooklyn, N. Y.

S & S HAND TACHOMETERS

Accurate as a precision watch. Made in six sizes, of three to four ranges each, up to 16,000 r.p.m. New bulletin on request.



Schuchardt & Schutte of New York
George Scherr Co., 142 W. Liberty St., N.Y.C.

Tycos Temperature Instruments
INDICATING - RECORDING - CONTROLLING

Industry favors *Tycos* indicating, recording and controlling instruments because they embrace every type and size needed to meet the exacting requirements of power plants.

Request complete data on them

Taylor Instrument Companies ROCHESTER N.Y.

JAGABI Speed Indicator

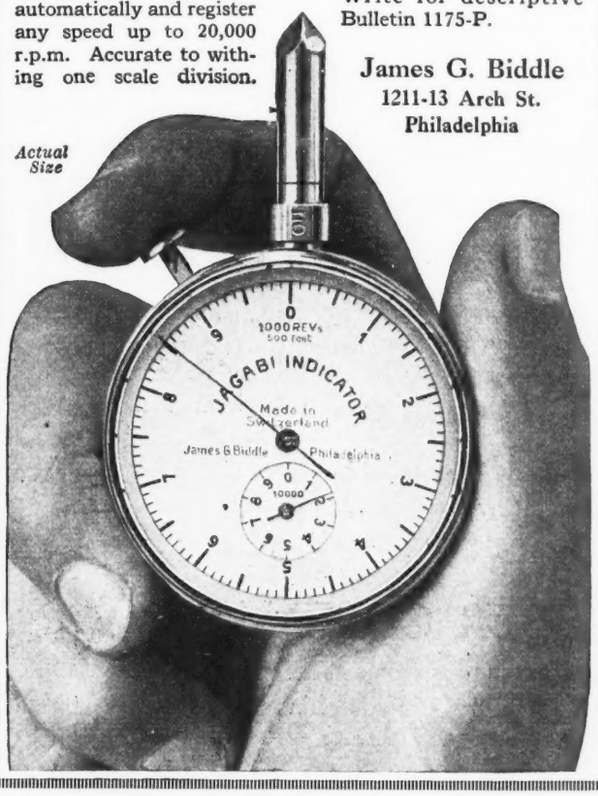
Just press and release the button. After three seconds the hands stop automatically and register any speed up to 20,000 r.p.m. Accurate to within one scale division.

Pocket case and accessories included.

Write for descriptive Bulletin 1175-P.

James G. Biddle
1211-13 Arch St.
Philadelphia

Actual Size



CONNEAUT *Plastic Metallic* PACKING

An adjustable metallic packing which does not deteriorate in service, wear or score the rod.

Gives years of service on rods of steam pumps or engines.

Also particularly adapted for high speed rotary pumps.

Forms any size with the fingers.

Manufactured by
The Conneaut Packing Company
Conneaut, Ohio

METALLO GASKETS

Indestructible asbestos cord laid in circular groove by protecting cover of copper is the basis of the Metallo Gasket—a gasket that is making an enviable record under the severest conditions. Write for ILLUSTRATED catalog and free samples.

METALLO GASKET COMPANY
New Brunswick, N. J.

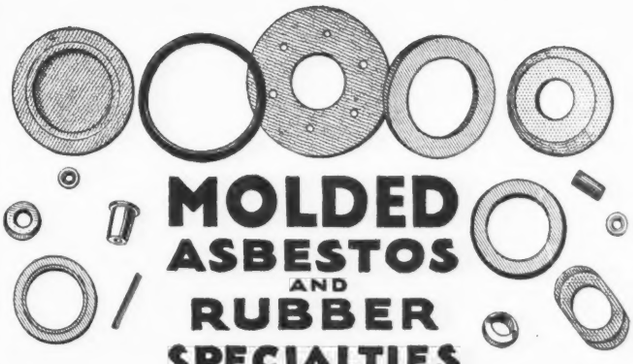
FRANCE

Metallic Packings of the Better Class

Ideal for superheated or saturated steam, ammonia, air or gas for all pressures and operating conditions. Last 5 to 25 years. Sold on approval.

Write for catalog and list of users.

FRANCE PACKING COMPANY
6600 Tacony St., Philadelphia, Pa.



MOLDED ASBESTOS AND RUBBER SPECIALTIES *for* Equipment Builders

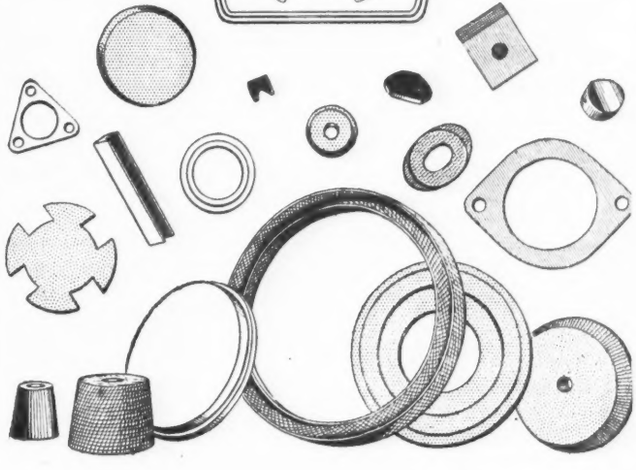
The Garlock Packing Company is equipped to produce various forms of Asbestos and Rubber Molded Specialties to the design and specification of the builder of any type of mechanical equipment.

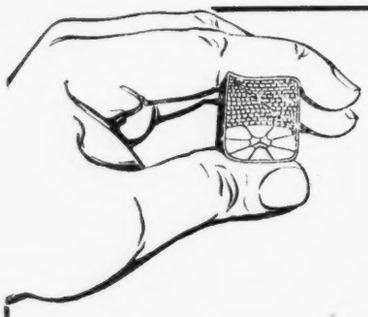
We maintain a complete Engineering and Sales Staff for consultation on any Mechanical Packing or Moulded Specialty Problem that may exist on the machine you manufacture.

Make use of this Service.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

CANADIAN GENERAL OFFICES, MONTREAL QUEBEC.





P.P.P. is self-adjusting
It cannot bind the rod

See how the free-moving wedges slide under pressure. When the pressure lessens, these wedges move back into the original position, and relax their bearing. That's why Daniel's P.P.P. cannot exert a fixed, unyielding binding on the rod.

Freedom from rod friction insures less wear on the rod and packing, with the result that P.P.P. gives twice the service rendered by rigid packings.

And in addition, P.P.P., by removing the friction drag, permits full engine power transmission to machinery.

P.P.P. through its longer life guarantees freedom from repacking troubles. It is thoroughly efficient under highest pressures and temperatures.

We will gladly send you sample for test.

If you have a leaking pipe line, causing frequent shutdowns and repacking, pack it with Ebonite Sheet Packing. It will hold joints tight. Send for sample.

QUAKER CITY RUBBER COMPANY

Manufacturers of mechanical rubber goods

Main offices and factories, Wissinoming, Philadelphia

Branches: New York Chicago Pittsburgh San Francisco

BLOW GUNS save compressed air

They operate with compressed air, entrain atmospheric air, discharge the mixture at suitable service pressure and reduce consumption of high pressure air 50%.

New bulletin 4T gives complete information

Try them for blowing out molds, cleaning off machines, etc.

SCHUTTE & KOERTING

1150 Thompson St., Philadelphia

See our ads. on pages 62 and 72

Alfit

The Last Word in PACKING

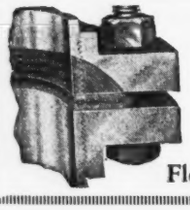
We can convince you MERIT WILL TELL

Alfit Mfg. Co. Inc.
154 Nassau St., N. Y.

BANROC INSULATION

"A fireproof, permanent, flexible insulation for all temperatures up to 1200 deg. F." Banroc Wool; Banroc Jacket; Banroc Pipe insulation; Banroc Cements (1800 deg. F.); Banroc High temperature Waterproofing. *Send for literature.*

BANNER ROCK PRODUCTS CO., ALEXANDRIA, INDIANA



"Flexitallic"

a flexible metallic gasket built on correct mechanical principles to withstand modern high pressures and temperature.

Flexitallic Gasket Co., Camden, N. J.

MAGNOLIA ANTI-FRICTION METAL

For Sale by Dealers Everywhere

Send for free Booklet

Magnolia Metal Co., 75 West St., New York

THE lubricating oil in each main and auxiliary turbine at the new Trenton Channel station of The Detroit Edison Company is kept clean by means of a De Laval Oil Purifier installed beside the unit as shown in the above illustration.

With such ultra-modern stations as Trenton Channel using them there is no need to tell you how and why De Laval Purifiers will insure for your lubricating oil the highest degree of purification obtainable by commercial methods. No need to tell you of the many savings in labor and wear and tear on machinery which follow the continued use of this oil.

De Lavals are simple to operate, designed in accordance with sound engineering principles and ruggedly constructed. Due to the relatively low speed at which they operate, they are exposed to little wear. Upkeep costs are almost negligible.

If you want detailed reasons for and concrete evidence of De Laval superiority write for Bulletin No. 106-P.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 600 Jackson Blvd., Chicago
DE LAVAL PACIFIC COMPANY, 61 Beale Street, San Francisco
THE DE LAVAL COMPANY, Ltd., Peterborough and Winnipeg, Canada
ALFA-LAVAL CO., Ltd., 34 Grosvenor Road, London, S. W. 1.

Here are a few representative users of De Laval Oil Purifiers among America's largest power systems—

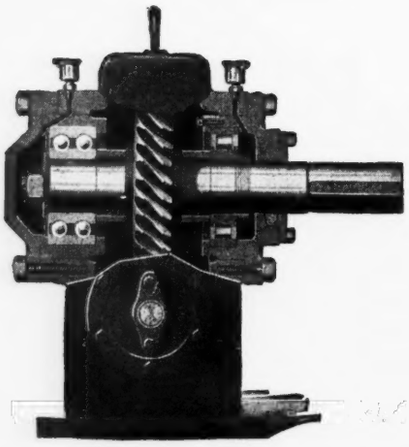
Hydro-Electric Power Commission of Ontario
Niagara Falls Power Company
Commonwealth Edison Company
Edison United Companies
Pacific Gas & Electric Company
Southern California Edison Company
The Detroit Edison Company
Philadelphia Electric Company
Public Service Electric & Gas Co.
Montana Power Company
Duquesne Light Company
Southern Power Company
West Penn System
Cleveland Electric Illuminating Co.
Alabama Power Company
Union Electric Light & Power Co.
Buffalo General Electric Company
Brooklyn Edison Company
Mississippi River Power Company

DE LAVAL
OIL PURIFIERS

Worm? Spur? Herringbone?

The type you need is built in—

Philadelphia SPEED REDUCING UNITS



Above—TYPE A-X WORM GEAR UNIT, designed especially for overhung load condition on gear shaft, without use of outboard bearing. Worm and shaft are integral with hardened and ground threads. Double row Ball Bearing is used to take both worm and gear thrust, with Heavy Duty Roller Bearing taking overhung load. Worm Gear is of chill cast Bronze.

You wouldn't deal with a merchant who sold only one size or style of shoes . . . or suits . . . or hats. Apply this same logic then, to your selection of speed reducers . . . think of the expert advisory service you can get from the maker of ALL TYPES of such units, for ALL drives, ALL ratios. Add to this an expert knowledge of metals, of gears, of problems of shaft alignment, lubrication, dust-protection . . . and you begin to realize why so many shrewd buyers come to PHILADELPHIA. Details? Gladly!

Main Office and Plant Erie Ave. and G St. Phila., Pa.

PHILADELPHIA GEAR WORKS

Manufacturers of Industrial Gears and Speed Reducing Units

PHILADELPHIA, PENNA.

Branch Sales and Engineering Offices:
New York, 12 East 41st St.

New! "John Crane" Style 170 Plastic Metallic

A resilient plastic packing made by a company you have known for years.

Recommended on centrifugal pump shafts, steam piston rods, valve stems for air, steam and for oil and water, both hot and cold.

Order out a complimentary sample or a 1, 3 or 5 pound can of this latest addition to the "John Crane" line of metallic packings.

Crane Packing Company,
1801 Cuyler Ave., Chicago
21 Bridge St., New York

Send small sample and price of "John Crane" Plastic Metallic.

Send..... lb. can

Name .....

Position .....

Company .....

Address .....

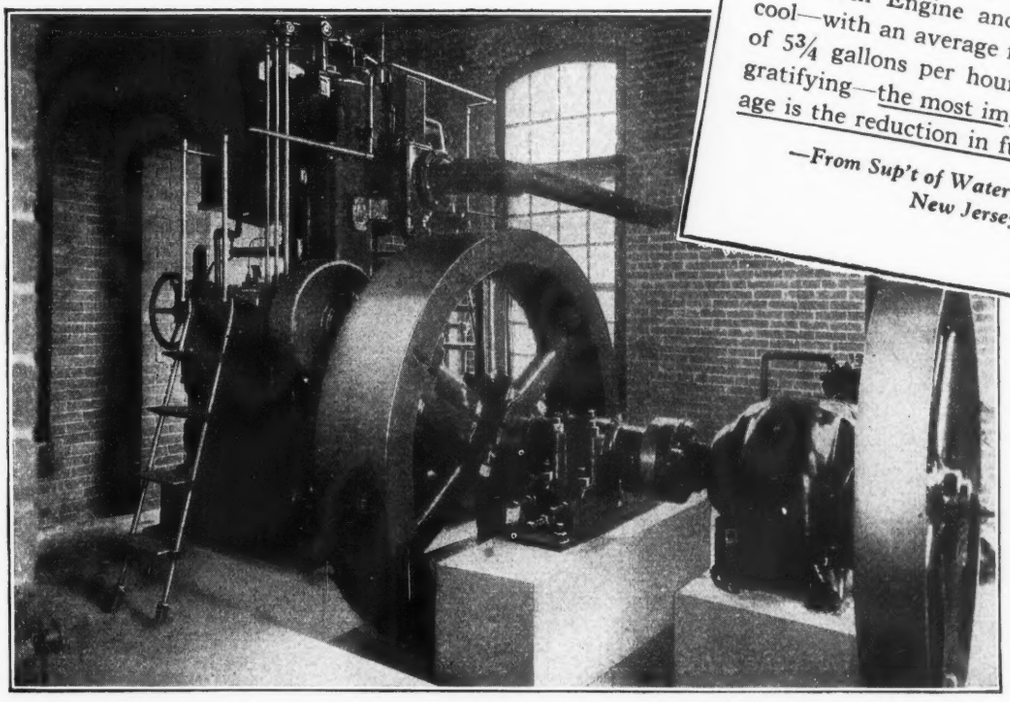
DODGE
MISHAWAKA
DODGE MANUFACTURING CORPORATION
Mishawaka, Indiana
The World's Marketplace for Industrial Equipment

Nuttall Gears
Pittsburgh

BEEN AT IT FOR THIRTY-FIVE YEARS
The BURT MFG. Co.
Ventilators-Oil Filters-Exhaust Heads
A Size and Type for Every Purpose
232 Main Street, Akron, Ohio

NUGENT OIL FILTERS
Oiling Systems
Oiling Devices
402 N. HERMITAGE AVE
CHICAGO U.S.A. ESTD 1897

UNFAILING POWER AT LOWEST COST *assured*



"We have run the Superior-Otto Diesel right thru without a shut-down, with both Engine and Pump running cool—with an average fuel consumption of 5¾ gallons per hour, which is very gratifying—the most important advantage is the reduction in fuel cost."

—From Sup't of Water Works of a New Jersey Summer Resort

The "quotation" shown above states in a few concise words, the concensus of opinion of all Otto Diesel users. In fact, there is no case on record, where an Otto has not "saved money."

For Municipal Lighting Plants, Pumping Stations and Industrial Power Plants, Superior-Otto Diesel Engines have proven invaluable. Always Economical and Reliable, these rugged prime movers have won the admiration and respect of all those who have them installed.

Incidentally, we have prepared a non-technical catalog regarding Superior-Otto Diesels, —which not only gives "Users' Opinions," but contains numerous "Installation Views." Copy upon request.

DIESEL
SUPERIOR-OTTO
ENGINE

The OTTO ENGINE WORKS, Rhawn Street and State Road, Philadelphia, Pa.

Gentlemen: Please send me your new Non-Technical Booklet "B."

Mr. ..... Title .....

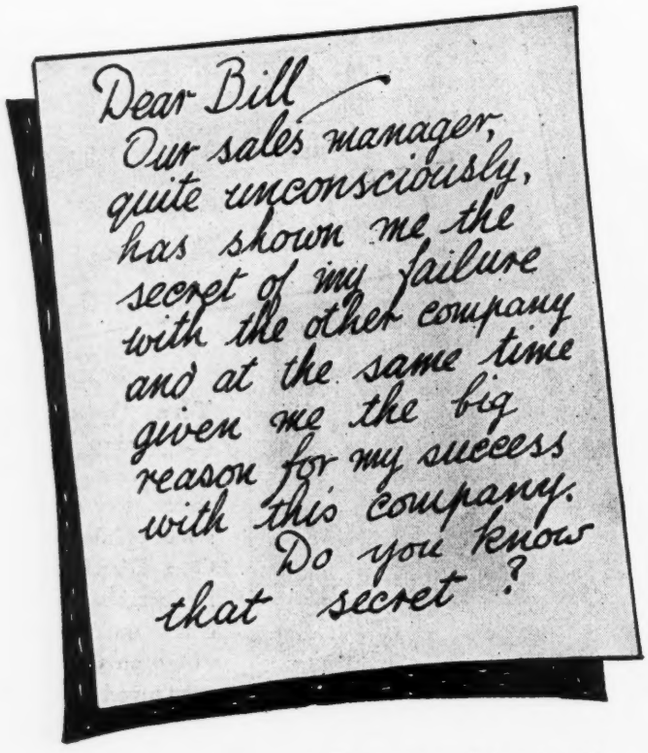
Firm Name .....

Street ..... City ..... State .....

P.12-28

This is one of a series of McGraw-Hill advertisements directed originally to advertising men in an effort to make industrial advertising more profitable to buyer and seller. It is printed in these pages as an indication to readers that McGraw-Hill publishing standards mean advertising effectiveness as well as editorial virility.

What happened here?


Dear Bill
Our sales manager, quite unconsciously, has shown me the secret of my failure with the other company and at the same time given me the big reason for my success with this company.
Do you know that secret?

(So wrote an industrial salesman to a McGraw-Hill friend.)

THIS salesman had resigned from his old firm because he never seemed to get beyond first base with his prospects.

(His old firm manifested an indifferent attitude toward Industrial Advertising. Consequently, so did all the salesmen. An advertisement was published now and then. There was no real advertising plan and no real investigation of industrial media. When an advertisement appeared it was crammed full of cuts and copy.)

* * * *

HE went with another company making a similar product and within one year made such progress that he was assigned the "hard-nut" territory.

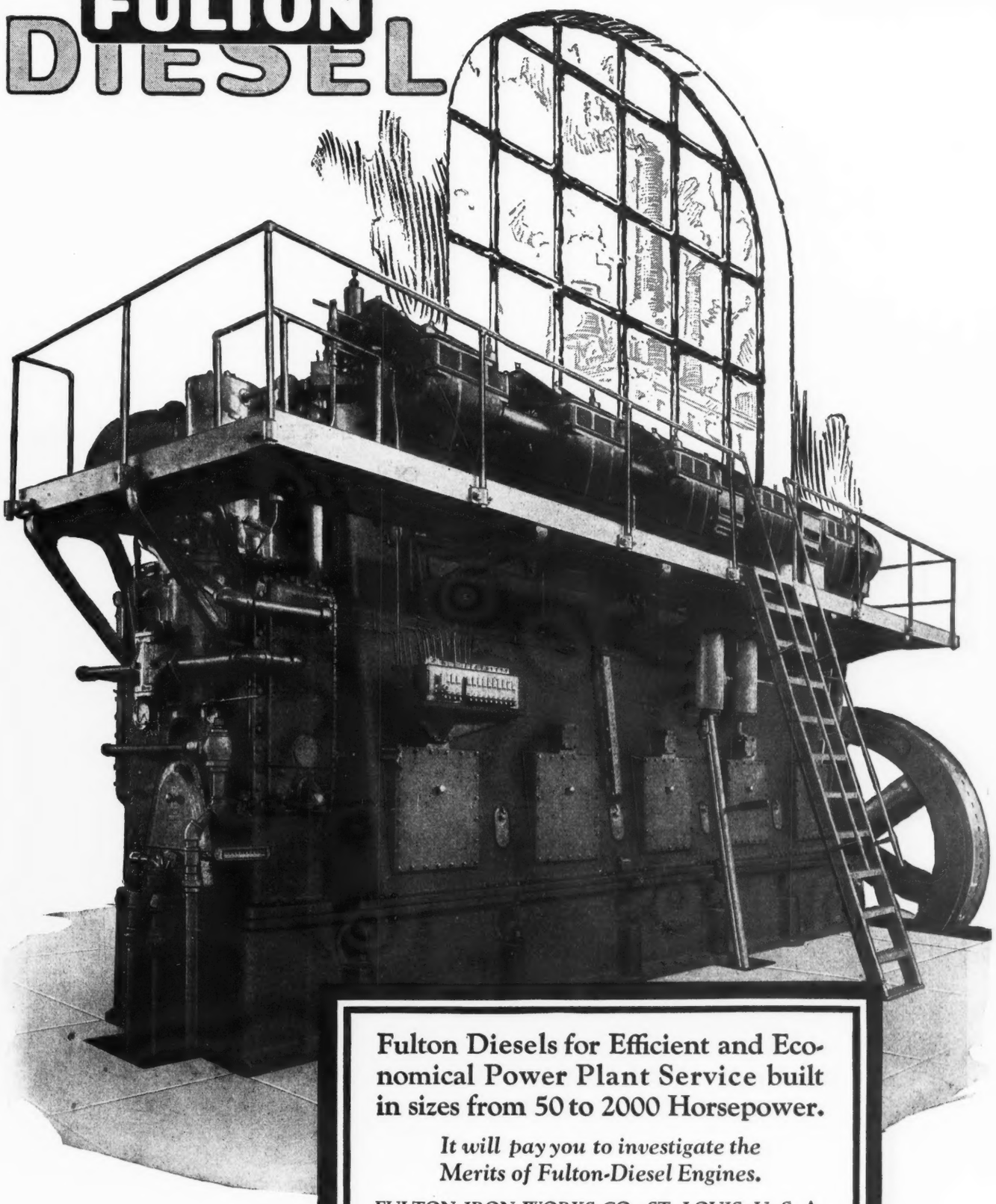
(His present firm invests $30,000 a year in specialized Industrial Advertising in four Industrial Publications. These publications are regularly read by the engineers and production men with whom this firm's salesmen are contacting. Between 110 and 125 advertisements are published annually. These total around 200 pages of full-page and double-page advertisements. Each advertisement describes one product only.)

GETTING industrial recognition of the engineering salesman and each product that he sells need not be a costly job, but it must be a specialized and continuous one. Industrial salesmen are realizing more and more the value of properly planned Industrial Advertising in securing for them that intimacy so helpful to both salesman and buyer.

—The publishers

F-6

FULTON DIESEL



Fulton Diesels for Efficient and Economical Power Plant Service built in sizes from 50 to 2000 Horsepower.

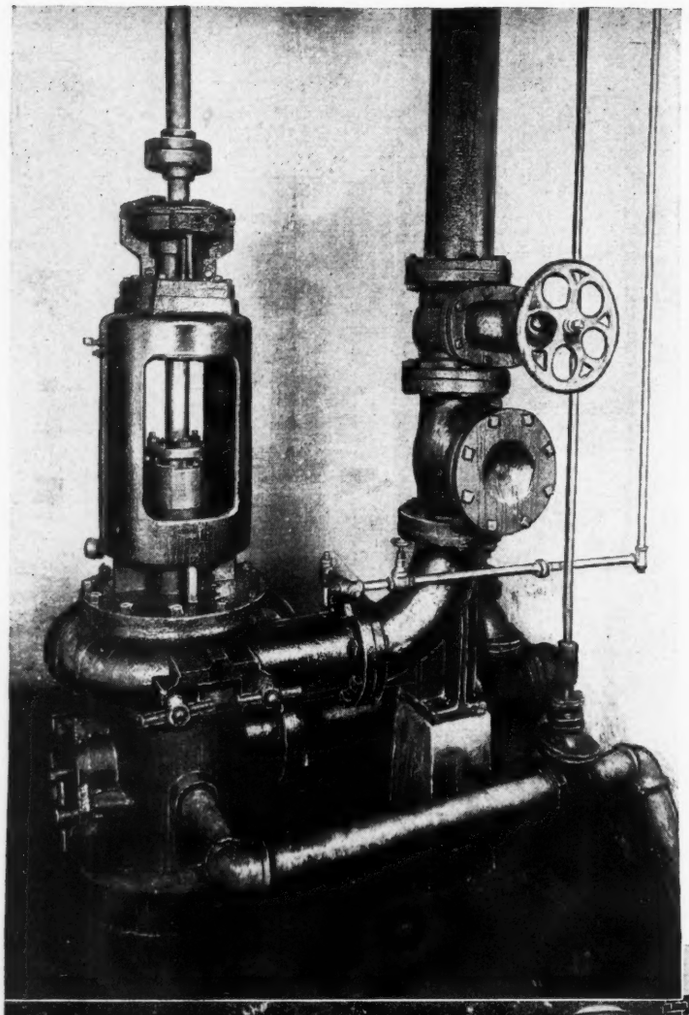
It will pay you to investigate the Merits of Fulton-Diesel Engines.

FULTON IRON WORKS CO., ST. LOUIS, U. S. A.

Successful Engine Builders for Over Seventy-five Years

PLANTS at St. Louis and Springfield, Ohio

BRANCH OFFICES - New York - Chicago - Springfield, Ohio - New Orleans - Tulsa, Okla. - Salt Lake City, Utah - Jacksonville, Fla. El Paso, Dallas, Texas - Monroe, La. - Wichita, Kan. Mobile, Ala. and Havana, Cuba



Simplified Sewage Handling

THE Buffalo Raw Sewage Pump shown here simplifies the disposal problem because of its design.

Being absolutely non-clogging, it requires little attention and infrequent inspection. Bearings are large and perfectly lubricated. Ample metal is used thruout.

Of the many Buffalo Raw Sewage Pumps now in use, not one of this design is unsatisfactory in any way.

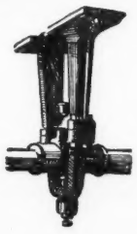
Write us for details of both vertical and horizontal types, and let us refer you to users.

Pumping Station at Maple Shade, N. J.

Buffalo Steam Pump Company

488 Broadway, Buffalo, N. Y.

In Canada—Canadian Blower & Forge Co., Ltd., Kitchener, Ont.



USG

To Lubricate all kinds of machinery bearings

For general lubricating purposes you can be sure of the best results, by using

MEXICAN GRAPHITE CUP GREASE

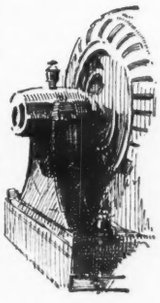
A combination of natural amorphous (not flake) graphite and a high quality grease derived from the best mineral oil. Made in four consistencies.

EXTRA SOFT—for high speed bearings, transmissions and sliding gears.

SOFT—Ideal for crank pins, crossheads, valve motions, eccentrics, slides, main journals, pillow blocks, etc. Will freely pass thru small holes and spring or compression lubricating cups.

MEDIUM—for use on open bearings and in screw or compression cups under high pressure.

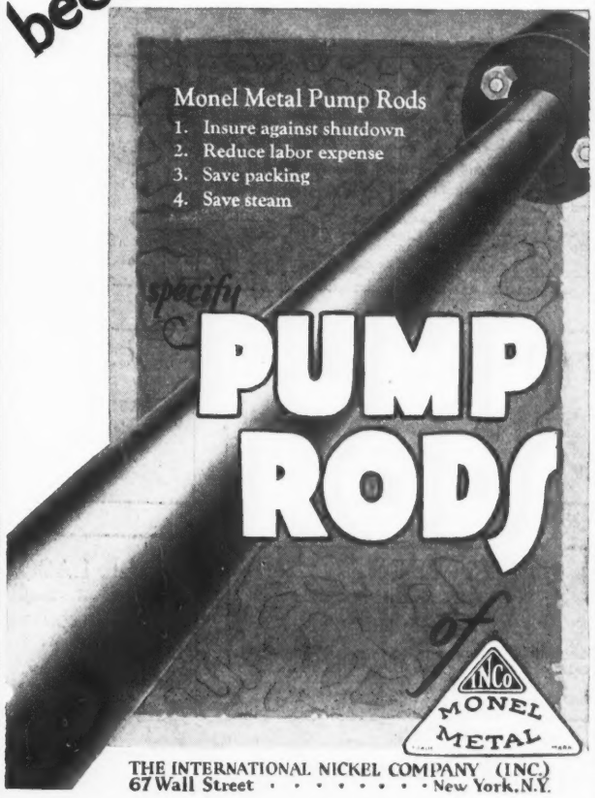
HARD—for heavy open bearings, cams, spindles, etc.



Write us for latest catalog.

The United States Graphite Co.
Saginaw, Mich.

because



THE INTERNATIONAL NICKEL COMPANY (INC.)
67 Wall Street · · · · · · · · New York, N.Y.

American Steel & Wire Company's *American* Wire Rope and AERIAL WIRE ROPE TRAMWAYS

AMERICAN STEEL & WIRE COMPANY

Sales Offices: Chicago, New York, Boston, Atlanta, Birmingham, Cleveland, Worcester, Philadelphia, Pittsburgh, Buffalo, Detroit, Cincinnati, Baltimore, Wilkes-Barre, St. Louis, Kansas City, Minneapolis, St. Paul, Oklahoma City, Memphis, Dallas, Denver, Salt Lake City, *San Francisco, *Los Angeles, *Portland, *Seattle.
*United States Steel Products Co.

EVERBRITE

Casting Metal

The Nickel Copper Alloy with unequalled casting properties, possessing exceptional strength and resistance to corrosion and erosion of steam at high pressures.

Send for Descriptive Booklet

AMERICAN MOND NICKEL COMPANY
CENTURY BUILDING · PITTSBURGH, PA.

The University of Wisconsin uses the

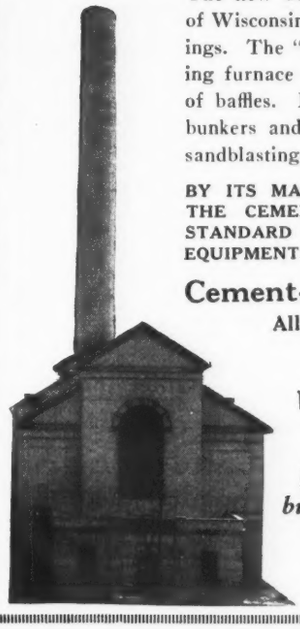
The quick, cheap way to cut costs in boiler plants

CEMENT-GUN TRADE MARK

The new boiler house of the University of Wisconsin, shown here, serves 93 buildings. The "Cement-Gun" is used for lining furnace walls and arches, and repair of baffles. It is also use for lining coal bunkers and tanks, concrete repairs, and sandblasting.

BY ITS MANY USES AND ECONOMIES THE CEMENT GUN HAS BECOME A STANDARD PIECE OF POWER PLANT EQUIPMENT.

Cement-Gun Company, Inc.
Allentown, Penna.



Write for our latest bulletin

POWER ENGINEERING SERVICE

J. G. BERGER
Electrical and Mechanical Engineer
Power Plants Designed. Plans for the proper use of Central Station Power. Reports, Plans and Specifications for the economic use of Power, Light, Heating and Process Steam in Paper and Textile Mills, Quarries, Hotels and other industries.
24 Commerce St. Newark, N. J.

FREYN ENGINEERING COMPANY
INDUSTRIAL
POWER PLANTS
310 South Michigan Ave.
Chicago, Ill.

A. A. LANGEWALD, Jr.
Consulting Engineer, Member A.S.M.E.
Appraisals, Power Plant Construction, Design, Renovation, and Tests, Electrical Distribution, Switchboard Layouts.
86 Essex St., Boston, Mass.

WILLIAM MILLER BOOTH
Power Plant
Economies
526 University Block, Syracuse, N. Y.

C. M. GARLAND & CO.
Engineers - Architects
DESIGN, CONSTRUCTION, REPORTS
Industrial Plants - Power Plants
Office and Other Buildings
First National Bank Bldg., Chicago

LORENZ & LORENZ
Consulting Engineers
Economy in steam power plants.
All problems of design and operation.
Domestic and Industrial fuel oil burner problems.
420 Lexington Ave., New York City
Tel. Lex. 10490

JOSEPH BRESLOVE
CONSULTING ENGINEER
POWER PLANTS
Specialist in the Application of Steam and Electric Power to Industrial Plants.
Oliver Building Pittsburgh, Pa.

HALL LABORATORIES, Inc.
R. E. Hall, Ph.D., Director.
CONSULTANTS ON
BOILER WATER CONDITIONING
304 Ross St. Pittsburgh, Pa.

CHAS. T. MAIN, Inc.
ENGINEERS
Plans and Specifications for Industrial Plants, Water Power and Steam Power Development. Examinations and Reports on Plants with reference to their Value. Reorganization or Development.
201 Devonshire Street. Boston, Mass.

CHAS. A. CAHILL & SONS
ENGINEERS
Power Plants — Water Supply
Industrial Surveys — Pumping Stations
Reports — Sewerage Systems
Plant Electrification — Industrial Buildings
Refrigeration
MILWAUKEE, WIS.

OTTOMAR H. HENSCHEL
Consulting Electrical and Mechanical Engineer
Room 401, Commerce Bldg.
Fourth and Wells Sts., Milwaukee, Wis.

MEYER, STRONG & JONES, Inc.
Power Plants—Mechanical and Electrical Equipment—Heating and Ventilating
101 Park Ave., New York City

Powdered Fuel *Combustion Problems*
J. G. COUTANT
International Fuel Engineer
Fuel Economy and Increased Capacity of Boiler and Industrial Furnaces. Consultation, Reports, Appraisals.
200 Madison Ave., New York City

EDGAR J. KATES
Design and Supervision of
DIESEL POWER PLANTS
203 West 13th St. New York City

W. E. MOORE & CO., Engrs.
Electric Power and Industrial Plants
Electric Furnace Engineering
Development, Design, Supervision
Union Bank Bldg., Pittsburgh, Pa.

W. E. S. DYER
Mill Engineer and Architect
Pulverized Fuel Plants and Specifications, Industrial Buildings, Textile Mills, Factories, Power Plants
Special Processes and Devices
Land Title Bldg., Philadelphia

ANDREW KIDD
Consulting Power Engineer
Examinations, Tests, Reports and Design of complete Power Plants — Investigation into use and economy of Central Station Power.
95 Liberty St., New York City

ARTHUR L. MULLERGREN
CONSULTING ENGINEER
Specialist in Electric Light
Power and Water
Pumping
Kansas City, Mo.

Electrical Testing Laboratories
Factory Inspection and Acceptance Tests of all Engineering Apparatus and Materials. Meter Calibrations. Fuel Analyses.
80th St. and East End Ave.
New York City

YOU can find the specific answer to your own power problem through this Directory of Engineering Service.

NEW YORK TESTING LABORATORIES
Analysis of
Coal, Ash, Oils, Water, Metals,
Electrical and Power Plant Tests
Inspectors of Materials
80 Washington St., New York City

Power Questions Can *Not* Be Answered In Wholesale Lots

Each individual industrial plant presents a set of highly individual problems that must be answered by expert assistance, taking into consideration all of the technical peculiarities of the plant under scrutiny.

You can find the specific answer to your power problem through this Directory of Engineering Service.

POWER ENGINEERING SERVICE

E. OGUR
Consulting Plant Engineer
Heat Balanced Generation, Distribution and Utilization of Power in Industrial Plants. Power House Tests. *Power Cost Accounting and Statements.* Design of Special Equipments.
Fisk Building, New York City

C. L. PARKER
Ex-Examiner U. S. Patent Office
Attorney-at-Law and Solicitor of Patents
Patent, Trade Mark and Copyright Law
McGill Bldg., WASHINGTON, D. C.

JOHN A. STEVENS
Consulting Power Engineer
16 Shattuck Street
Lowell, Massachusetts

OPHULS & HILL, Inc.
Formerly
Ophuls, Hill & McCreery, Inc.
CONSULTING ENGINEERS
Ice Making and Refrigeration
Investigations and Reports
112-114 West 42nd St., New York City

SCOFIELD ENGINEERING CO.
CONSULTING ENGINEERS
Public Utilities—Industrial Plants
Designs—Reports—Valuations
Philadelphia, Pa.

WEBSTER TALLMADGE
Specialist in
Steam Engineering
Orifice Distribution and Zoned Heating
System Designs
50 Church St. New York City

WALTER L. OSWALD
Specialist in
CONDENSATION DRAINAGE AND RETURN AND BOILER FEEDING SYSTEMS
Associated with
HENRY A. MORSE
3912 Woolworth Bldg. New York

W. J. SQUIRE
CONSULTING ENGINEER
Railways—Power Plants
Industrial Power and Illumination
Transmission Lines, Appraisals and Reports
618 Dwight Bldg., Kansas City, Mo.

CHARLES H. THAYER
Electrical Tests and Calibrations
Specialist in Meter Calibrations
Standardizing Laboratory
Worcester Polytechnic Institute
Power Surveys
Pleasant Street, Ashland, Mass.

Modernization means more—

than scrapping old machinery and equipment. Modernization means scrapping old ideas, out-of-date policies, rule of thumb methods. Modernization means wiping the cobwebs out of your own brain and letting in the sunlight of modern ideas. Modernization means consulting this directory if you need expert professional advice on any of your engineering, operating, or management problems.

SEARCHLIGHT SECTION

POSITIONS VACANT

DRAFTSMAN wanted by New Jersey company, manufacturing centrifugal pumps; preferably one experienced in this field. P-646, Power, Tenth Ave. at 36th St., New York.

New Jersey

WANTED, man who has been in charge of production and personnel of machine shop. Must be familiar with up to date methods in handling accurate machining and assembly of high-speed machines weighing three to five tons, such as turbines. Opportunity for advancement. Give full information; name salary desired in first application. P-657, Power, Tenth Ave. at 36th St., New York.

Ohio

MAN wanted experienced in plant maintenance, and power plant operation by industrial manufacturing plant, employing approximately 1,100 men, and operating a 1,400 hp. steam plant. When replying, advise age, past experience, education, present position and salary expected. P-654, Power, 7 South Dearborn Street, Chicago, Ill.

Pennsylvania

HIGH-GRADE draftsman, particularly familiar with detail design of centrifugal pumps. P-635, Power, Tenth Ave. at 36th St., New York.

EMPLOYMENT SERVICE

$3,000.00-$30,000.00 men find our service effective in making connections. Individual. Confidential. Refund agreement. Not agency. Jacob Penn, Incorporated, 9 Park Place, New York.

IF YOU are qualified for position between $2,500 and $25,000 and are receptive to negotiations for new connection, your response to this announcement is invited. The undersigned provides a thoroughly organized service, established nineteen years ago, to conduct confidential preliminaries, and assist the qualified man in locating the particular position he desires. Not a registration bureau. Retaining fee protected by refund provision, as stipulated in our agreement. Send name and address only for description of service. R. W. Bixby, Inc., 270 Main Street, Buffalo, New York.

POSITIONS WANTED

New York

SOME organization, manufacturing or selling power plant equipment, should have a position open, for a mechanical designer to handle installation problems, particularly one who has had fifteen years' experience as designer and squad leader on industrial and power plant layouts. PW-656, Power, Tenth Ave. at 36th St., New York.

POSITIONS WANTED

Pennsylvania

GRADUATE ENGINEER, age 31, desires to make connection with progressive concern. Eight years' experience. Present time chief engineer large production plant. Extensive experience on installation, plant operation, machine design. Best of references. PW-655, Power, Tenth Ave. at 36th Street, New York.

Wyoming

COMPETENT power plant engineer wants position—chief, assistant chief, or shift engineer; $2,000 or better. PW-652, Power, 7 South Dearborn St., Chicago, Ill.

SALESMAN AVAILABLE

SALES ENGINEER with considerable experience in power plant equipment, power and steam specialties, supplies, etc. Excellent connections. Open for engagement. Will consider any territory. P. O. Box 518 C. S., Toledo, Ohio.

An Engineer

with 17 years' experience in Electrical Construction would like to buy an interest in a reputable contracting or small Power and Light Co. Can invest $10,000.

BO-649, Power,
Tenth Ave. at 36th St., New York City

Big Sacrifice

OIL ENGINES

4—500 H.P.

Can be shown in operation. Quick action necessary.

ZELNICKER IN ST. LOUIS

Specialists in Oil Engines

Oil Engine Bulletin listing over 100 engines various sizes, is yours for the asking.

Thirty years in Rails, Equipment, Heavy Machinery, Steel Piling, Tanks, Pipe, etc.

FOR SALE

TURBO-GENERATOR

G. E. 4000-kw., 2300-v.; condenser, Alberger low-head jet type; step-up transformer, 2300/33000-v.; rotaries, 3—400-kw., 600-v., 3 ph.; motor, 150 hp., 2300-v. synchronous belted; generator; 150-kw. revolving-field belted; switchboard, piping, cables, etc. All 25 cycle. Other 25 cycle equipment will be described upon receipt of inquiry.

THE SCIOTO VALLEY RAILWAY AND POWER COMPANY
Columbus, Ohio

FOR SALE

ENGINE SET

14x22x30 Hewes & Philips Tandem Compound, Corliss Engine, direct connected to Westinghouse 150 kw., 250 v., 125 r.p.m., D.C. Generator, complete with low level jet condenser and switchboard panels. Entire apparatus in excellent condition. Can be seen carrying load.

THE RUBEROID CO.
Bound Brook, N. J.

---

600 H.P. BOILERS

3—600 hp. Heine, 200 lb. working pressure. Price $6.00 per horse, f.o.b. Chicago. Many other bargains in Boilers, Green Economizers, Generator Sets, etc.

Lakeside Machinery Company
567-71 West Lake Street, Chicago, Ill.

FOR SALE

1—Ingersoll-Rand Imperial, type XB, Two-Stage **Compressor,** 19 x 16, 12x16 cylinders, with Allis-Chalmers D.C. Motor.

2—Manistee Rees Roturbo **Pumps,** size 6—2½ B2.

All in excellent condition.

1—National Elec. **Motor,** D.C., 250 v.

Bell & Zoller Coal & Mining Co.
307 No. Michigan Ave., Chicago, Ill.

FOR SALE

CORLISS ENGINE

18-in.x36-in., Hewes & Phillips. Diameter flywheel 14 ft. x 24 in. face. Excellent condition; used recently.

THE SIPP MACHINE CO.
Paterson, N. J.

CONDENSER BARGAINS

Surface Type: 2,000; 4,000; 5,000; 6,000; 7,000; 25,000 sq.ft.
LeBlanc Jet Type: 300; 500; 1,000; 1,500; 2,000; 3,000; 5,000; 8,000; 10,000 kw. capacity units.

PAUL STEWART & COMPANY
TURBO & POWER SPECIALISTS, CINCINNATI

WANTED

FOR SALE

Material for the Construction of a Radial Brick Chimney

200 ft. high, internal top diameter 9 ft., base diameter 17 ft. 6 in.

New York Power and Light Corp.
Salvage Division, Purchasing Department
Albany, N. Y.

1—18x21 **Lentz Poppet Valve Engine,** direct connected to 1—250 kw., 3-/60-200 r.p.m. Electric Machinery A.C. Generator, belted exciter, can be seen operating.

Unit to be replaced by larger equipment. Priced right for quick sale.

FS-658, Power
7 So. Dearborn St., Chicago, Ill.

WANTED

GENERATOR

about 225 Kva., capacity 440 volt, 60 cycle, 3 phase, 514 or 450 r.p.m., preferably 3 bearing.

W-653, Power
Tenth Ave. at 36th St., New York City

One New Schutte-Koerting Multi-jet No. 31 Condenser and 16″ check valve for sale.

VAL. BLATZ BREWING CO.
Milwaukee, Wis.

FOR SALE

GENERATOR

150 kw. direct current, 3-wire system 220-125 volt direct connected to 16x20 Erie Ball four valve engine.

GEO. G. McLAUGHLIN MFG. CO.,
115 Federal St., Room 207, Boston, Mass.

WANTED

Bleeder Turbine With Condenser

500 kva., 60 cycle, 3 phase, 240 volt. Surface condenser preferred.

CHAS. A. CAHILL & SONS
214 Mason Street, Milwaukee, Wis.

SOME one wants to buy the equipment you are not using. Sell it before depreciation scraps it.

Write today to SEARCHLIGHT DEPARTMENT, 10th Ave. at 36th St., New York City.

MOTOR GENERATORS

1—240 KW, 250 volt, 1200 r.p.m., type MPC, General Elec., compound wound interpole generator direct connected to a 330 KVA (350 HP.), 3 phase, 60 cycle, 2300 volt, 1200 r.p.m., .85 P.F., type ATI, General Elec. synchronous motor complete with panels. Machine mounted on common cast iron base. Price $2,750.

1—150 KW, 250 volt, Sprague generator to a 290 HP., 3 phase, 60 cycle, 2300 volt, 600 r.p.m., type ATI, General Elec. synchronous motor with belt driven exciter, flexible coupling, rheostat for generator and starter for motor. Price, $1,400.

1—150 KW, Westinghouse, type SK191, compound wound, 550 volt, 900 r.p.m., direct connected to 225 HP. Westinghouse synchronous motor, 3 phase, 60 cycle, 4000/2300 volt, 900 r.p.m., with direct connected exciter, type SK40, 3 bearing, on common cast iron base without accessories. Price, $1,500.

Other Sizes in Stock.

ROTARY CONVERTERS

1—450 KW, 55 deg., 300 KW, 35 deg., 600 volt, 1200 r.p.m., type HCC, form P, Gen. Elec. rotary converter with 3 General Elec. transformers, 150 KW, 60 deg., 2 hours, 33,000 volts primary, 60 cycle with choke coils, disconnect switches, lightning arresters and a.c. and d.c. panels.

1—300 KW, 275 volt, 1200 r.p.m., compound wound, interpole, type HCC Gen. Elec. with transformers for 3 phase, 60 cycle, 2300 volts, a.c. and d.c. panels.

D. C. ENGINE UNITS

1—125 KW, 125 volt, Gen Elec. (West. Elec.), type MPC generator to 15 x 16 Skinner unaflow engine, 250 r.p.m.

1—150 KW, 125 volt, Gen. Elec., type MPC to 19 x 20 Ames unaflow engine, 200 r.p.m.

1—75 KW, Burke, 3 wire, 125/250 volt to 13 x 18 Erie Ball, 4 valve engine.

1—125 KW, Burke, 3 wire, 125/250 volt to a 15 x 20 Erie Ball, 4 valve engine, 200 r.p.m.

1—175 KW, Burke, 3 wire, 125/250 volt to a 17 x 20 Erie Ball, 4 valve engine, 200 r.p.m.

Other sizes in stock.

A.C. ENGINE UNITS

1—150 KVA, 120 KW at .8 P.F., 3 phase, 60 cycle, 225 r.p.m., 2300-230 volt, General Elec. with direct connected exciter, to a 13½ x 16, Harrisburg, 4 valve engine.

1—185 KW, 1 P.F., 3 phase, 60 cycle, 2300 volt, type ATB, form E, Gen. Elec. generator to an 18 x 20 Skinner Unaflow engine, 225 r.p.m., with exciter.

1—250 KVA, 200 KW, 3 phase, 60 cycle, 2300-480-240 volt, Westinghouse generator direct connected to a 21 x 22, 200 r.p.m., Skinner Universal Unaflow engine with 15 KW, type SK, Westinghouse exciter.

TURBO GENERATOR UNITS

1—10,000 KVA, 8,000 KW, 3 phase, 60 cycle, 11,000-6,600-2300 volt, Westinghouse generator to a Westinghouse multiple expansion parallel flow steam turbine 150-200 lbs. steam pressure, 28-in. vacuum with Westinghouse-LeBlanc condenser with air and circulating pumps.

1—3750 KVA, (3,000 KW), .8 P.F., 3600 r.p.m., 2300 volt, 3 phase, 60 cycle, type ATB, Gen. Elec. turbo generator, temperature rise on stator is 60 deg. C and rotor 85 deg. C. The excitation is 24 KW, 125 volts.

TRANSFORMERS, 5500 KW, in sizes up to 100 KW, mostly built in 1920 to 1926. Good as new at money-saving prices.

INQUIRIES SOLICITED

GEORGE SACHSENMAIER CO., 8403 Hegerman St., Holmesburg, Philadelphia, Pa.

BOILERS

Ready for immediate delivery

2—550 H.P. Edge Moor, 175-lb. pressure.
4—400 H.P. Stirling, 150-lb. pressure.
3—350 H.P. B. & W., 200-lb. pressure.
2—400 H.P. Wickes, 150-lb. pressure.
1—440 H.P. Edge Moor, 150-lb. pressure.
2—350 H.P. Stirling, 200-lb. pressure.
4—450 H.P. Stirling, 180-lb. pressure.
3—389 H.P. Heine, 180-lb. pressure.

Several good fire Box H.R.T. and Vertical fire tube boilers.

Also several makes, sizes and pressures of new boilers available for quick shipment. We will undertake to completely erect these boilers. I also want to buy good boilers.

J. F. DAVIS, 111 W. Monroe St., Chicago, Ill.

MOTOR BARGAINS
NEW AND USED

EVERY motor sold is guaranteed. Write for our low prices on your requirements.

SLIP RING MOTORS

Hp.	Make	Ph.	Cy.	Volts	Rpm
300	Allis-Chal.	3	60	220/440	870
280	Fair.-Morse	3	60	220/440	600
175	Allis-Chal.	3	60	550	600
100	Westg. (C.W.)	3	60	550	600
100	Westg. (C.W.)	2	60	220	600
100	Westg. (C.W.)	3	60	220/440	600

Other slip-ring motors down to ¼ hp.

SQUIRREL CAGE MOTORS

150	G. E.	3	25	440	375
150	G. E. (K.T.)	3	60	2200	870
100	Cr.-Wh.	3	60	220/440	1750
75	Cr.-Wh.	3	60	220/440	1160
50	Gen. Elec.	3	60	220/440	900

Other squirrel cage motors down to ¼ hp.

DIRECT CURRENT MOTORS
All 220 volts-230 volts

Hp.	Make	Speed
120	Sprague (C)	450/900
100	Sprague (C)	550/1100
60	Westg. (S)	920
50	Westg. (S)	750/955

Other D.C. motors down to ¼ hp.

Write for complete stock list.

L. J. LAND
142 Grand St., N. Y. C.

BOILERS

2—300 HP. Keeler horizontal water tube, 150 lbs. press.
1—250 HP. Heine horizontal water tube, 160 lbs. press. A.S.M.E. code.
1—150 HP., 72-in. x 18-ft. horizontal return tubular, 160 lbs. press. A.S.M.E. code suspension set.

A. C. GENERATOR UNITS

2—150 KW, 220 volt, 3 phase, 60 cycle, G.E. with Ames Aut. engine.
1—150 KW, 2300 v., 3 phase, 60 cycle, Westinghouse with Chuse uniflow engine.
1—50 KVA, 220 volt, 3 phase, 60 cycle, Crocker Wheeler with Erie ball horizontal auto. engine.

THE O'BRIEN MACHINERY CO.
113 NORTH THIRD ST.
PHILADELPHIA, PA.

350 H.P. Busch Diesel Unit

350 hp. Busch Sultzer Bros. Diesel Oil Engine direct connected to 250 volt direct current Generator. Practically new, kept like a fine watch; substitute alternator available.

SACRIFICE BARGAIN FOR IMMEDIATE WIRED ACCEPTANCE

Paul Stewart and Company
Cincinnati, Ohio

RANDLE

OFFERS BIG BARGAINS

IN

Used and Rebuilt Engine Generator Sets, Turbo Generator Sets, Motors, Rotary Converters, Generators, Motor Generator Sets, Engines, Boilers, Steam and Electric Machinery of all kinds, also Machine Tools. Send for our new machinery list. Yours for the asking. Established Over 50 Years.

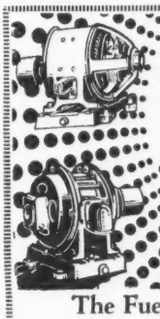
The RANDLE MACHINERY CO.
1768 Powers St., Cincinnati, O.

BOILERS

1—350 hp. Babcock & Wilcox Water Tube Boiler with B. & W. Chain Grate Stoker 200 lb. Pressure.
2—350 hp. Babcock & Wilcox Water Tube Boilers with B. & W. Chain Grate Stokers 200 lb. Pressure.
1—125 hp. Vertical Steam Boiler 125 lb. Pressure.
1—70 hp. Vertical Steam Boiler 125 lb. Pressure.
1—100 hp. H. R. T. Steam Boiler 125 lb. Pressure.
2—Kewanee No. 14 Brick Set Type Boilers 15 lb. Pressure 6500 sq. ft. capacity each.

When in the market for Boilers send us your requirements.

Industrial Machinery & Supply Company
6143 Wentworth Avenue, Chicago, Ill.



A FRACTIONAL HP MOTOR OR A COMPLETE POWER PLANT

Save 35 to 60%

MORE THAN 8000 MOTORS, GENERATORS, TRANSFORMERS AND OTHER ELECTRICAL MACHINERY IN STOCK.

EVERY MACHINE COMPLETELY RE-MANUFACTURED AND TESTED, GUARANTEED FULLY *Write for Stock Bulletin*

The Fuerst-Friedman Co.
1290 East 53rd St., Cleveland, O.

FOR SALE

1—Westinghouse 780 kva. **Turbo Generator Set,** 440 volt, 3 phase, 60 cycles, low pressure.
2—200 hp. Ames **HRT Boilers,** 150 lb., A.S.M.E. Mass. standard.
1—250 hp. **Scotch Marine Boiler,** 160 lb.

CONSOLIDATED PRODUCTS CO., INC.
14-17 Park Row, N. Y. C. Barclay 0600

FOR SALE

2—Allis Chalmers Motors

HP. 50/100, volts 110/220, r.p.m. 250 to 500 with 110 volts in armature, 500 to 1000 with 220 volts in armature. Shunt wound with interpoles. Cutler-Hammer Control Panels. Drum type Controller to get speed change by shunt field control. Inquiries and offers invited

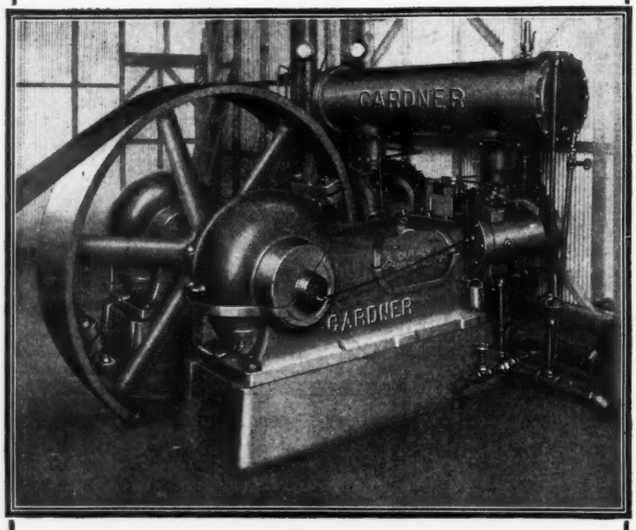
THE MANHATTAN RUBBER MFG. CO.
Passaic, N. J.

FOR SALE

Obsolete and Surplus Machinery

by large food product manufacturer; plants at Chicago and Detroit.
FS-647, Power
7 So. Dearborn St, Chicago, Ill.

Where Clean Assembly Is Vital



THE YELLOW TRUCK & COACH MFG. COMPANY maintains that continued and dependable performance of its products is greatly aided by extreme care in assembly.

All parts are thoroughly cleaned of dirt, grit and foreign matter by Gardner-Denver Compressors before they are assembled into the finished product.

All Gardner-Denver Products are built in the same careful manner—every part being exposed to a bath of clean, dry air before assembly.

Give your product a better send off and a better chance.

We would be glad to send you our bulletins XH-5, HAC-33 and HAC-34

GARDNER-DENVER COMPANY
QUINCY, ILL. DENVER, COLO.

GARDNER DENVER

You can't do better!

Sonderglass

Sudden changes in temperature won't hurt "Sonderglass." It is always clear.

The Reflecting Type has a red and white enameled back, making the water line easily visible in darker places.

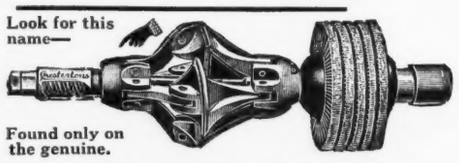
Order direct or ask for our nearest agent.

A. W. Chesterton Company
64 India Street, Boston, Mass.

Reflecting Type

For a job of thorough soot removal

Look for this name—



Found only on the genuine.

The "Combination" Tube Cleaner and Brush

A double-duty cleaner. It works coming and going. A dealer can buy an imitation for less. **But How About You?**

A. W. Chesterton Company
64 India St., Boston, Mass.

or

Advance Packing & Supply Company
808 Washington Blvd., Chicago, Ill.

modern boilers everywhere are cleaned by modern methods with DIAMOND SOOT BLOWERS

DIAMOND POWER SPECIALTY CORPORATION DETROIT, MICH.

GENERAL REFRACTORIES COMPANY

106 South 16th St., Philadelphia, Pa.

Fire Clay, Silica, Chrome, Magnesite and Diaspore (High Alumina) Refractories. Grefco Chrome High Temperature Cement.

Branch Offices: Buffalo Chicago Cleveland Detroit
New York Seattle (Representative—F. T. Crowe) Pittsburgh
Montreal, Canada (Representatives—Webster & Sons, Ltd.)

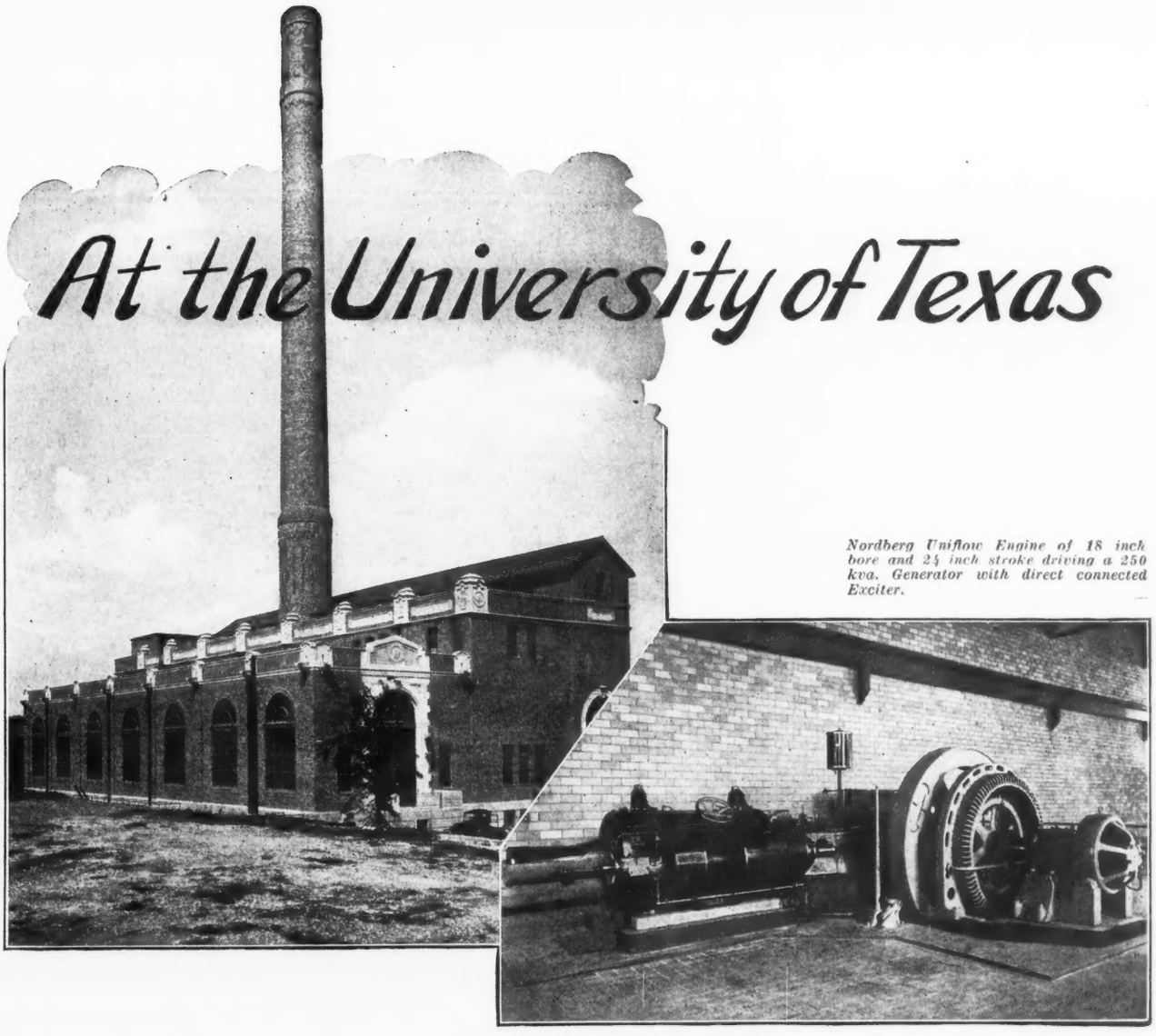
VULCAN SOOT CLEANER COMPANY

MAIN OFFICE DU BOIS PA. OFFICES IN THIRTY CITIES

Webster Bldg., DuBois, Penna.

Soot Cleaners For All Types of Water Tube and Return Tubular Boilers, Super-Heaters and Economizers.

At the University of Texas



Nordberg Uniflow Engine of 18 inch bore and 24 inch stroke driving a 250 kva. Generator with direct connected Exciter.

The University of Texas at Austin has just completed its new power plant, a model of its kind. In keeping with the other modern features is the installation of a Nordberg Uniflow Engine, which possesses many advantages for this kind of service.

Built to meet the present day tendencies of high pressure and superheat, its exceptionally high efficiency is of particular interest to those concerned with economy of operation.

Nordberg has developed a complete line of engines in the Uniflow and straight poppet valves types to meet the varying power conditions prevailing in industrial applications. These designs assure of a type that will perform most efficiently and render the best service. The satisfactory performance of Nordberg Steam Engines and their many satisfied users is the best proof of the kind of service these engines give.

Nordberg Engineers because of their wide experience in aiding in the solution of power problems are amply qualified to serve you. Submit your problem to them. Write for Bulletin R-1.

Nordberg Mfg. Co., Milwaukee, Wis.

Builders of Steam and Diesel Engines for any service

NORDBERG

WHAT AND WHERE TO BUY

Equipment, Apparatus and Supplies Used in the Power Plant Field with Names and Addresses of Manufacturers and Distributors Whose Advertisements Appear in This Issue

See Last Page for Alphabetical Index

Aftercoolers and Receivers, Air
Alberger Heater Co., Buffalo
Braun & Co., C. F., Alhambra
Foster-Wheeler Corp., N. Y.
Griscom-Russell Co., N. Y.
Ingersoll-Rand Co., N. Y.
Nordberg Mfg. Co., Milwaukee
Pennsylvania Pump & Compressor Co., Easton

Air Chambers
Hercules Float Wks., Springfield

Air Washers
Spray Engineering Co., Boston
Sturtevant Co., B. F., Hyde Park

Alternators, Turbo
General Electric Co., Schenectady
Elliott Co., Jeannette, Pa.

Arches, Boiler Door
McLeod & Henry Co., Troy, N. Y.

Arches, Flat, Suspended
Bernitz Furnace Appliance Co., Boston
Biglow-Liptak Corp., Detroit
CoKal Stoker Corp., Chicago
Detrick Co., M. H., Chicago
McLeod & Henry Co., Troy, N. Y.

Ash Gates and Hoppers for Pulverized Fuel
Allen, Sherman, Hoff Co., Phila.

Ash Handling Equipment
Allen, Sherman, Hoff Co., Phila
Beaumont Co., R. H., Philadelphia
Combustion Engineering Corp., N.Y.
Detrick Co., M. H., Chicago
International Combustion Engrg. Corp., N. Y.
Link-Belt Co., Chicago

Ash Quenchers
Allen, Sherman, Hoff Co., Phila
Beaumont Co., R. H., Philadelphia

Ash Sluicing Systems
Allen, Sherman, Hoff Co., Phila.

Baffle Contractors Boiler
Boiler Engineering Co., Newark

Baffle Walls, Boiler
Bigelow-Liptak Corp. Detroit
Boiler Engineering Co., Newark
King Refractories Co., Buffalo
McLeod & Henry Co., Troy, N. Y
Page Contracting Co., Fred'k, N. Y.

Baffles, Monolithic
Boiler Engineering Co., Newark
King Refractories Co., Buffalo

Baffles Walls, Monolithic
Boiler Engineering Co., Newark

Bearings
Dodge Mfg. Corp., Mishawaka
Magnolia Metal Co., N. Y.

Belting
Greene, Tweed & Co., N. Y.
Quaker City Rubber Co., Wissinoming

Belting, Conveyor
Keasbey & Mattison Co., Ambler

Belting, Rubber
Quaker City Rubber Co., Wissinoming

Bins, Coal and Ash
Beaumont Co., R. H., Philadelphia
Industrial-Brownhoist Corp., Cleveland

Bins, Portable
Beaumont Co., R. H., Philadelphia

Blowers, Centrifugal
De Laval Steam Turbine Co., Trenton
Elliott Co., Jeannette, Pa.
General Electric Co., Schenectady
Sturtevant Co., B. F., Hyde Park
Wing Mfg. Co., L. J., N. Y.

Blowers, Fan
Buffalo Forge Co., Buffalo
Clarage Fan Co., Kalamazoo, Mich
Engineer Co., N. Y.
General Electric Co., Schenectady
Sturtevant Co., B. F., Hyde Park
Wing Mfg. Co., L. J., N. Y.

Blowers, Forced & Induced Draft
Air Preheater Co., N. Y.
Buffalo Forge Co., Buffalo
Clarage Fan Co., Kalamazoo, Mich
Corpus Engineering Corp., Worcester
McClave-Brooks Co., Scranton, Pa.
Prat-Daniel Corp., N. Y.
Sturtevant Co., B. F., Hyde Park
Wing Mfg. Co., L. J., N. Y.

Blowers, Soot for Boiler Tubes
Diamond Power Specialty Corp., Detroit
Marion (Ind.) Mach., Fdry. & Supply Co.
Vulcan Soot Cleaner Co., Du Bois

Blowers, Steam Jet
McClave-Brooks Co., Scranton, Pa.

Blowers, Turbine
Elliott Co., Jeannette, Pa.
Ingersoll-Rand Co., N. Y.
Moore Steam Turbine Corp., Wellsville, N. Y.
Sturtevant Co., B. F., Hyde Park
Terry Steam Turbine Co., Hartford
Wing Mfg. Co., L. J., N. Y.

Boiler Compound
Dearborn Chemical Co., Chicago
Garratt-Callahan Co., Chicago

Boiler Fronts
McClave-Brooks Co., Scranton, Pa

Boiler Insulation
Celite Products Co., Los Angeles
General Insulating Mfg. Co., Alexandria, Ind.
Keasbey & Mattison Co., Ambler

Boiler Setting
Bernitz Furnace Appliance Co., Boston
Biglow-Liptak Corp., Detroit
Cement Gun Co., Allentown
CoKal Stoker Corp., Chicago
Custodis Chimney Constr. Co., Alphons, New York
Detrick Co., M. H., Chicago
Keystone Refractories Co., N. Y.
Laclede-Christy, St. Louis
Lavino & Co., E. J., Philadelphia
Obermeyer Co., S. Chicago
Page Contracting Co., Fred'k, N. Y.
Plibrico Jointless Fire Brick Co., Chicago
Queens Run Refractories Co., Lock Haven
Rust Engineering Co., Pittsburgh

Boiler Tube Cleaners
(See Blowers, Soot, and Boiler)
(See Scale Removers)
(See Tube Cleaners Boiler)

Boilers, Locomotive
Connelly Boiler Co., D., Cleveland

Boilers, Return Tubular
Coatsville (Pa.) Bolier Works
Connelly Boiler Co., D., Cleveland
Hedges-Walsh & Weidner Boiler Co., Chattanooga
Murray Iron Wks. Co., Burlington
Union Iron Works, Erie, Pa.
Vogt Mach. Co., Henry, Louisville

Boilers, Waste Heat
Combustion Engineering Corp., N.Y.
Edge Moor (Del.) Iron Co
Heine Boiler Co., N. Y.
International Combustion Eng. Corp., N. Y.
Ladd Water Tube Boiler Co., Pittsburgh
Wickes Boiler Co., Saginaw

Boilers, Water Tube, Cross Drum, Horizontal, Inclined, Vertical
Babcock & Wilcox Co., N. Y
Combustion Engineering Corp., N.Y
Connelly Boiler Co., D., Cleveland
Edge Moor (Del.) Iron Co.
Hedges-Walsh & Weidner Boiler Co., Chattanooga
International Combustion Eng. Corp., N. Y.
Kingsford Fdy. & Mach. Co., Oswego, N. Y.
Ladd Water Tube Boiler Co., Pittsburgh
Murray Iron Wks. Co., Burlington.
Springfield (Ill.) Boiler Co
Union Iron Works, Erie, Pa.
Vogt Machine Co., Henry, Louisville
Wickes Boiler Co., Saginaw, Mich

Bolts, Nuts, Monel Metal
International Nickel Co., N. Y

Bolts, Nuts, Nickel
American Mond Nickel Co., Pittsburgh

Breechings
Connery & Co., Philadelphia
Griscom-Russell Co., N. Y.
Heine Boiler Co., N. Y.

Brick, Fire
Babcock & Wilcox Co., N. Y.
Bartley Crucible Co., Jonathan, Trenton
Bernitz Furnace Appliance Co., Boston
Evens & Howard Fire Brick Co., St. Louis
General Refractories Co., Phila
Harbison-Walker Refractories Co., Pittsburgh
Laclede-Christy, St. Louis
Lavino & Co., E. J., Philadelphia
McLeod & Henry Co., Troy, N. Y.
Obermayer Co., S. Chicago
Plibrico Jointless Fire Brick Co., Chicago
Queens Run Refractories Co., Lock Haven

Brick, Fire, Cement and Mortar
Babcock & Wilcox Co., N. Y.
Quigley Furnace Specialties Co., N. Y.

Brick, Fire, Plastic
Babcock & Wilcox Co., N. Y.

Brick, Insulating
Bernitz Furnace Appliance Co., Boston

Bucket Carriers, Pivoted
Link-Belt Co., Chicago

Buckets, Clam Shell
Industrial-Brownhoist Corp., Cleveland

Buckets, Elevator
Dodge Mfg. Corp., Mishawaka
Link-Belt Co., Chicago

Bunkers, Coal
Allen, Sherman, Hoff Co., Phila
Beaumont Co., R. H., Philadelphia
Industrial-Brownhoist Corp. Cleveland
Link-Belt Co., Chicago

Burners, Fuel Oil
Peabody Engineering Corp., N. Y.

Burners, Gas
Gas Combustion Co., Pittsburgh
Peabody Engr. Corp., N. Y.

Burners, Oil
Coen Co., San Francisco
Combustion Service Corp., Brooklyn
Hammel Oil Burning Equipt. Co., Providence
International Combustion Engrg. Corp., N. Y.
Schutte & Koerting Co., Philadelphia

Burners, Powdered Coal
Fuller-Lehigh Co., Fullerton, Pa.
Peabody Engineering Corp., N. Y.

Bushings
Magnolia Metal Co., N. Y.

Castings, Brass and Iron
Neemes Fdry. Inc., Troy

Castings, Chilled Iron
Fuller-Lehigh Co., Fullerton

Castings, Grey Iron
Fuller Lehigh, Fullerton
Riley Stoker Corp., Worcester

Castings, Monel Metal
International Nickel Co., N. Y.

Cement, Fire Brick
Babcock & Wilcox Co., N. Y.
Celite Products Co., Los Angeles
General Refractories Co., Phila.
Keystone Refractories Co., N. Y.
King Refractories Co., Buffalo
Lavino & Co., E. J., Philadelphia
McLeod & Henry Co., Troy, N. Y
Obermayer Co., S. Chicago
Plibrico Jointless Fire Brick Co., Chicago

Cement, High Temperature
Babcock & Wilcox Co., N. Y.
Banner Rock Products Co., Alexandria
King Refractories Co., Buffalo
Lavino & Co., E. J., Philadelphia

Cement, Iron
Obermayer Co., S. Chicago
Smooth-On Mfg. Co., Jersey City

Cement, Pipe Joint
Smooth-On Mfg. Co., Jersey City

Cement Placing Machines
Cement Gun Co., Allentown

Chain Drive
Link-Belt Co., Chicago
Philadelphia (Pa.) Gear Works

Chimneys (See Stacks)

Chemicals, Water Treating
National Aluminate Co., Chicago

Circuit Breakers
I. T. E. Circuit Breaker Co., Philadelphia

Clamps, Pipe
Smooth-On Mfg. Co., Jersey City
Yarnall-Waring Co., Phila.

Clutches, Friction
Dodge Mfg. Corp., Mishawaka
Link-Belt Co., Chicago

Coal
Peale, Peacock & Kerr, N. Y.
Pittsburgh (Pa.) Coal Co.

Coal Crushers
American Pulverizer Co., St. Louis
Beaumont Co., R. H., Philadelphia
Combustion Engineering Corp., N.Y
Fuller Lehigh Co., Fullerton, Pa.
International Combustion Eng. Corp., N. Y.
Link-Belt Co., Chicago
Strong-Scott Mfg. Co., Minneapolis

Coal Handling Equipment
Beaumont Co., R. H., Philadelphia
Hunt Co., C. W., West New Brighton, N. Y.
Industrial-Brownhoist Corp., Cleveland
Link-Belt Co., Chicago

Coating-Anti-Corrosive
Dampney Co. of America, Boston

Coating, Boiler Tube
Dampney Co. of America Hyde Park, Boston

Coating, Boiler Wall
Celite Products Co., Los Angeles

Cocks, Brass & Iron Body
Homestead (Pa.) Valve Mfg. Co.

Cocks, Gage
Nason Mfg. Co., N. Y.

Cocks, Steam
Dart Mfg. Co., E. M., Providence
Homestead (Pa.) Valve Mfg. Co.
Lunkenheimer Co., Cincinnati

Combustion Chamber, Back Arch
CoKal Stoker Corp., Chicago
Detrick Co., M. H., Chicago
McLeod & Henry Co., Troy, N. Y.
Obermayer Co., S. Chicago

Combustion Control Systems
Hagan Corp., Pittsburgh
Smoot Engr. Corp., N. Y.

CO_2 Recorders and Flue Gas Analysis Instruments
Permutit Co., N. Y.
Republic Flow Meters Co., Chicago

Compressors, Air
Allis-Chalmers Mfg. Co., Milwaukee
Gardner-Denver Co., Quincy
General Electric Co., Schenectady
Ingersoll-Rand Co., N. Y.
Nash Engineering Co., So. Norwalk
Nordberg Mfg. Co., Milwaukee
Pennsylvania Pump & Compressor
Sullivan Machinery Co., Chicago

Compressors, Ammonia
Ingersoll-Rand Co. N. Y.

Compressors, Gasoline
Sullivan Machinery Co., Chicago

Compressors, Extraction
Sullivan Mchy. Co., Chicago

Compressors, Thermo
Foster-Wheeler Corp., N. Y.

Condensers, Barometric, Combined, Jet, Surface
Alberger Heater Co., Buffalo
Allis-Chalmers Mfg. Co., Milwaukee
Buffalo (N. Y.) Steam Pump Co.
Elliott Co., Jeannette, Pa
Foster Wheeler Corp., N. Y.
Ingersoll-Rand Co., N. Y
Kellogg Co., M. W., N. Y.
Nordberg Mfg. Co., Milwaukee
Schutte-Koerting Co., Phila.
Wheeler Mfg. Co., C. H., Phila.

Controllers, Electric
General Electric Co., Schenectady

Converters, Synchronous
Elliott Co., Jeanette, Pa.

Conveying Machinery
Dodge Mfg. Corp., Miskawaka

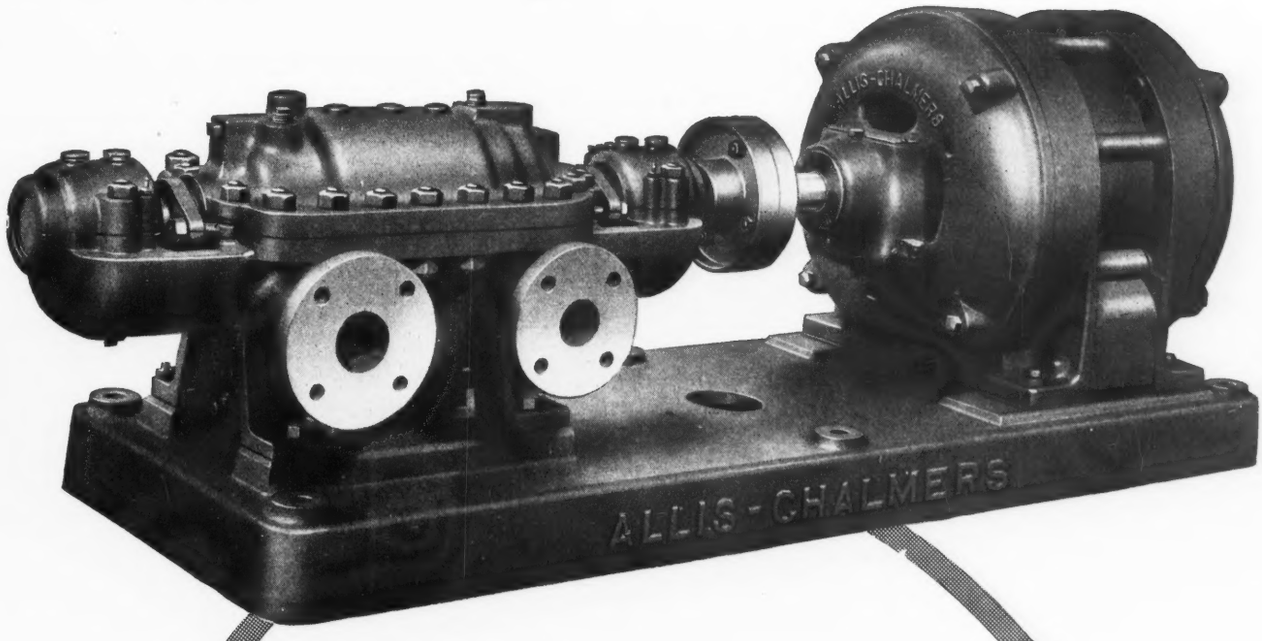
Conveyors, Belt
Beaumont Co., R. H., Philadelphia
Industrial-Brownhoist Corp., Cleveland
Link-Belt Co., Chicago

Conveyors, Portable
Link-Belt Co., Chicago

Coolers, Generator
General Electric Co., Schenectady
Griscom-Russell Co., N. Y.
Spray Engineering Co., Boston
Sturtevant Co., B. F., Hyde Park

Coolers, Oil
Alberger Heater Co., Buffalo
Griscom-Russell Co., N. Y
Schutte & Koerting Co., Philadelphia

Allis-Chalmers Centrifugal Boiler Feed Pumps



The Boiler Feed Pumps of Undivided Responsibility

This means one Company selects and stands back of a complete unit of its own manufacture consisting of both pump and drive. The pump illustrated is the smallest size we have recently developed for feeding boilers of from seven hundred fifty to sixteen hundred boiler horse power. It is built with the same care and along the same lines as our well known boiler feed pumps of larger sizes. Your inquiry will bring you our recommendations for the best Centrifugal Pumping Unit for boiler feed or other service.

ALLIS-CHALMERS

MILWAUKEE, WIS. U. S. A.

Coolers, Water
Badger & Sons Co., E. B., Boston
Marley Co., Kansas City
Vogt Mach. Co., Henry, Louisville

Cooling Plants and Ponds
Badger & Sons Co., E. B., Boston
Marley Co., Kansas City, Mo.
Spray Engineering Co., Boston
Yarnall-Waring Co., Phila.

Cooling Towers
Foster Wheeler Corp., N. Y.
Marley Co., Kansas City
Wheeler Mfg. Co., C. H., Phila.

Couplings, Flexible Shaft, Rigid, Shaft
De Laval Steam Turbine Co., Trenton, N. J.
Nicholson & Co., W. H., Wilkes-Barre
Philadelphia (Pa.) Gear Works
Terry Steam Turbine Co., Hartford

Covering, Pipe & Boiler
Banner Rock Products Co., Alexandria, Ind.
Celite Products Co., Los Angeles
General Insulating Mfg. Co., Alexandria, Ind.
Keasbey & Mattison Co., Ambler
Lavino & Co., E. J., Philadelphia
Obermayer Co., S. Chicago

Cranes
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Industrial-Brownhoist Corp., Cleveland

Cranes, Creeper, Type, Locomotive, Gas and Steam
American Hoist & Derrick Co., St. Paul
Industrial-Brownhoist Corp., Cleveland
Link-Belt Co., Chicago

Cut-outs, Electric
General Electric Co., Schenectady

Cutters, Boiler Tubes
(See Pipe Cutters)

Dampers
Clarage Fan Co., Kalamazoo, Mich

Deaerators
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.

Dealers Machinery
(See Searchlight Section)
Bolling & Co., Stewart
Commonwealth Edison Co.
Davis, J. F.
Fuerst-Friedman Co., The
Kehoe Machinery Co., Robt. P.
Land, L. J.
Nashville Industrial Corpn.
O'Brien Mchy. Co.
Power Plant Equipment Co.
Randle Mchy. Co.
Sachsenmaier, Geo.
Stewart & Co., Paul

Desuperheaters
Elliott Co., Jeanette, Pa.
Schutte & Koerting Co., Philadelphia

Die Stocks
Toledo (Ohio) Pipe Threading Mach

Distilling Apparatus (Water)
Griscom-Russell Co., N. Y.

Draft, Mechanical
(See Blowers, Fan)

Drainers, Low Pressure
Cochrane Corp., Phila.

Drop Forgings
Ingersoll-Rand Co., N. Y.
Vogt Mach. Co., Henry, Louisville

Duct Insulation
Banner Rock Products Co., Alexandria, Ind.
General Insulating Mfg. Co., Alexandria, Ind.

Dust Collectors
Sturtevant Co., B. F., Hyde Park

Dynamometers
Wheeler Mfg. Co., C. H., Phila

Dynamos (See Generators)

Economizers
Alberger Heater Co., Buffalo
Foster Wheeler Corp., N. Y.
Green Fuel Economizer Co., Beacon, N. Y.
Sturtevant Co., B. F., Hyde Park

Ejectors
Chaplin-Fulton Mfg. Co., Pittsburgh
Elliott Co., Jeanette, Pa.
Nash Engineering So., So. Norwalk

Electors, Air
Elliott Co., Jeannette, Pa
Wheeler Mfg. Co., C. H., Phila.

Electors, Water
Consolidated Ashcroft Hancock Co., Inc., N. Y.

Electric Generating Sets, Steam Turbine
Allis-Chalmers Mfg. Co., Milwaukee
Elliott Co., Jeannette, Pa.
Moore Steam Turbine Corp., Wellsville, N. Y.
Sturtevant Co., B. F., Hyde Park
Terry Steam Turbine Co., Hartford

Elevator Rope
American Steel & Wire Co., Chicago

Elevators and Conveyors
Beaumont Co., R. H., Philadelphia
Industrial-Brownhoist Corp., Cleveland
Link-Belt Co., Chicago

Engine Generators
Elliott Co., Jeanette, Pa.

Engines, Corliss
Allis-Chalmers Mfg. Co., Milwaukee
Elliott Co., Jeanette, Pa.
Nordberg Mfg. Co., Milwaukee

Engines, Diesel
Fulton Iron Works Co., St. Louis
Nordberg Mfg. Co., Milwaukee
Otto Engine Works, Philadelphia

Engines, Gas and Oil
Allis-Chalmers Mfg. Co., Milwaukee
Fulton Iron Works Co., St. Louis
Ingersoll-Rand Co., N. Y.
Otto Engine Works, Philadelphia
Sterling Engine Co., Buffalo

Engines, Poppet-Valve
Elliott Co., Jeanette, Pa.

Engines, Steam
Air Preheater Corp., N. Y.
Allis-Chalmers Mfg. Co., Milwaukee
Clarage Fan Co., Kalamazoo, Mich.
Elliott Co., Jeannette, Pa.
Fulton Iron Works Co., St. Louis
Murray Iron Wks. Co., Burlington
Sturtevant Co., B. F., Hyde Park
Troy (Pa.) Engine & Machine Co.

Engines, Unaflow
Elliott Co., Jeanette, Pa.
Nordberg Mfg. Co., Milwaukee

Evaporators
Foster Wheeler Corp., N. Y.
Griscom-Russell Co., N. Y.

Exhaust Heads
Burt Mfg. Co., Akron
Hoppes Mfg. Co., Springfield, O.
Sturtevant Co., B. F., Hyde Park
Swartwout Co., Cleveland

Exhausters, Gas
Sturtevant Co., B. F., Hyde Park

Expansion Joints
Badger & Sons Co., E. B., Boston
Elliott Co., Jeanette, Pa.
Foster Wheeler Corp., N. Y.
Grinnell Co., Providence
Griscom Russell Co., N. Y.
Howard Iron Works, Buffalo
Wheeler Mfg. Co., C. H., Phila.

Fans, Exhaust and Ventilator
(See Blowers, Fan)

Fans, Forced & Induced Draft
Coppus Engineering Corp., Worcester
Green Fuel Economizer Co., Beacon
Sturtevant Co., B. F., Hyde Park

Feed Water Treatment
National Aluminate Co., Chicago

Feeders, Pulverized Coal
Fuller-Lehigh Co., Fullerton

Filters, Feed Water, Pressure—Water
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.
Griscom-Russell Co., N. Y.
Permutit Co., N. Y.

Filters, Oil
Burt Mfg. Co., Akron
Bowser & Co., S. F., Ft. Wayne
Elliott Co., Jeannette, Pa.
Nugent & Co., Wm. W., Chicago

Filters, Oil Removal
Elliott Co., Jeanette, Pa.
Griscom-Russell Co., N. Y.
Permutit Co., N. Y.

Filters, Oil System
Bethlehem (Pa.) Steel Co.
Burt Mfg. Co., Akron

Fire Extinguishers
Badger & Sons Co., E. B., Boston

Fire Hydrants
Howard Iron Works, Buffalo

Firebox Blocks
Bernitz Furnace Appliance Co., Boston
McLeod & Henry Co., Troy, N. Y.

Fittings, Ammonia
Greene, Tweed & Co., N. Y.
Vogt Machine & Co., Henry, Louis-

Fittings, Steel
Crane Co., Chicago
Pittsburgh (Pa.) Pipe & Equip. Co.

Flanges
Dart Mfg. Co., E. M., Providence
Grinnell Co., Providence
Jefferson Union Co., Lexington,
Pittsburgh (Pa.) Piping & Equip Co.
Power Piping Co., Pittsburgh
Vogt Machine Co., Henry, Louisville

Floats
Hercules Float Wks., Springfield, Mass.

Flooring, Fireproof
Tri-Lok Co., Pittsburgh

Flooring, Non-Slipping
Tri-Lok Co., Pittsburgh

Flooring, Open Steel
Tri-Lok Co., Pittsburgh
Flooring, Steel
Tri-Lok Co., Pittsburgh

Flooring, Ventilating
Tri-Lok Co., Pittsburgh

Forgings, Monel Metal
International Nickel Co., N. Y.

Fuel Oil Systems
Bowser & Co., S. F., Ft. Wayne
Coen Co., San Francisco
Combustion Engineering Corp., N. Y.
Hammel Oil Burning Equipt. Co. Providence
International Combustion Engr. Corp., N. Y.
Peabody Engineering Corp., N. Y.

Furnace Arches
Biglow-Liptak Corp., Detroit
Detrick Co., M. H., Chicago
Lavino & Co., E. J., Philadelphia
McLeod & Henry Co., Troy, N. Y.
Obermayer Co., S. Chicago
Queens Run Refractories Co., Lock Haven

Furnace Bottoms, Cast Iron Air Cooled
Allen, Sherman, Hoff Co., Phila
Beaumont Co., R. H., Philadelphia

Furnace Construction
Bigelow-Liptak Corp., Detroit
Cement Gun Co., Allentown
Lavino & Co., E. J., Philadelphia
Plibrico Jointless Fire Brick Co., Chicago

Furnace Linings
American Engineering Co., Phila.
Babcock & Wilcox Co., N. Y.
Bigelow-Liptak Corp., Detroit
Cement Gun Co., Allentown
General Refractories Co., Phila.
Harbison-Walker Refractories Co., Pittsburgh
Keystone Refractories Co., N. Y.
Laclede-Christy, St. Louis
Lavino & Co., E. J., Philadelphia
McLeod & Henry Co., Troy, N. Y.
Obermayer Co., S. Chicago
Plibrico Jointless Fire Brick Co., Chicago
Queens Run Refractories Co., Lock Haven

Furnace Walls, Water Cooled
American Engineering Co., Phila.
Combustion Eng. Corp., N. Y.
Foster Wheeler Corp., N. Y.
International Combustion Eng. Corp., N. Y.

Furnaces
American Engineering Co., Phila.
Bernitz Furnace Appliance Co., Boston
Combustion Engineering Corp., N. Y.
Detroit (Mich.) Stoker Co.
Fuller Lehigh Co., Fullerton, Pa.
International Combustion Engineering Corp., N. Y.
McClave-Brooks Co., Scranton, Pa.

Furnaces, Bagasse & Wood Burning
Bigelow-Liptak Corp., Detroit
Combustion Engineering Corp., N. Y.
Detrick Co., M. H., Chicago
International Combustion Engineering Corp., N. Y.
McClave-Brooks Co., Scranton, Pa.

Furnaces, Incinerator
Combustion Engineering Corp., N. Y.
International Combustion Engineering Corp., N. Y.
McClave-Brooks Co., Scranton, Pa.

Fuses
General Electric Co., Schenectady

Gage Glass Guards & Shields
Jenkins Bros., N. Y.
Gage Glasses
Chesterton Co., A. W., Boston

Gages, Differential, Draft, Liquid Depth, Pressure, Recording Vacuum, Water
Bailey Meter Co., Cleveland
Bristol Co., Waterbury
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Crosby Steam Gage & Valve Co., Boston
Greene, Tweed & Co., N. Y.
Republic Flow Meters Co., Chicago
Yarnall-Waring Co., Philadelphia

Gas Burning Equipment
Coen Co., San Francisco
Peabody Engineering Corp., N. Y.

Gas Exhausters
General Electric Co., Schenectady

Gaskets
Flexitallic Gasket Co., Camden, N. J.
Garlock Packing Co., Palmyra, N. Y
Greene, Tweed & Co., N. Y.
Keasbey & Mattison Co., Ambler
Metallo Gasket Co., New Brunswick
Quaker City Rubber Co., Wissinoming
Smooth-On Mfg. Co., Jersey City, N.J.

Gates, Air Blast
McClave-Brooks Co., Scranton.

Gates, Coal & Ash Bin
Allen, Sherman, Hoff Co., Phila.
Beaumont Co., R. H., Philadelphia
Gifford Wood Co., Hudson
Hunt Co., C. W., West New Brighton, N. Y.
Industrial-Brownhoist Corp., Cleveland
Link-Belt Co., Chicago

Gauges
American Schaeffer & Budenberg Corp., Div. Consolidated Ashcroft Hancock Corp., Brooklyn

Gears
General Electric Co., Schenectady
Link-Belt Co., Chicago
Nuttall Co., R. D., Pittsburgh
Philadelphia (Pa.) Gear Works

Gears, Double Helical
De Laval Steam Turbine Co., Trenton, N. J.

Gears, Reduction
De Laval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
ville, N. Y.
Moore Steam Turbine Corp., Wells
Nuttall Co., R. D., Pittsburgh
Philadelphia (Pa.) Gear Works
Sturtevant Co., B. F., Hyde Park
Terry Steam Turbine Co., Hartford

Generating Sets
Elliott Co., Jeanette, Pa.
General Electric Co., Schenectady
Sturtevant Co., B. F., Hyde Park

Generators, Electric
Elliott Co., Jeanette
General Electric Co., Schenectady
Sturtevant Co., B. F., Hyde Park

Governors, Pressure
Northern Equipment Co., Erie

Governors, Pump
Atlas Valve Co., Newark
Chaplin-Fulton Mfg. Co., Pittsburgh
Davis Regulator Co., G. M., Chicago
Gardner-Denver Co., Quincy
Northern Equipment Co., Erie
Swartwout Co., Cleveland

Graphite
Greene, Tweed & Co., N. Y.
United States Graphite Co., Saginaw

Grates, Dumping
Auburn (Ind.) Stoker Corp.
Babcock & Wilcox Co., N. Y.
CoKal Stoker Corp., Chicago
Combustion Eng. Corp., N. Y.
Cyclone Grate Bar Co., Buffalo
International Combustion Engineering Corp., N. Y.
Kelly Foundry & Machine Co. Goshen
McClave-Brooks Co., Scranton, Pa
Marion (Ind.) Mach., Fdry. & Supply Co.
Neemes Fdry., Inc., Troy
Riley Stoker Corp., Worcester
Vogt Mach. Co., Henry, Louisville

Grates, Shaking
Auburn (Ind.) Stoker Corp.
Babcock & Wilcox Co., N. Y.
CoKal Stoker Corp., Chicago
Combustion Eng. Corp., N. Y.
Cyclone Grate Bar Co., Buffalo
International Combustion Engineering Corp., N. Y.
Kelly Foundry & Machine Co. Goshen
McClave-Brooks Co., Scranton, Pa.
Marion (Ind.) Mach., Fdry. & Supply Co.
Neemes Fdry., Inc., Troy
Vogt Mach. Co., Henry, Louisville

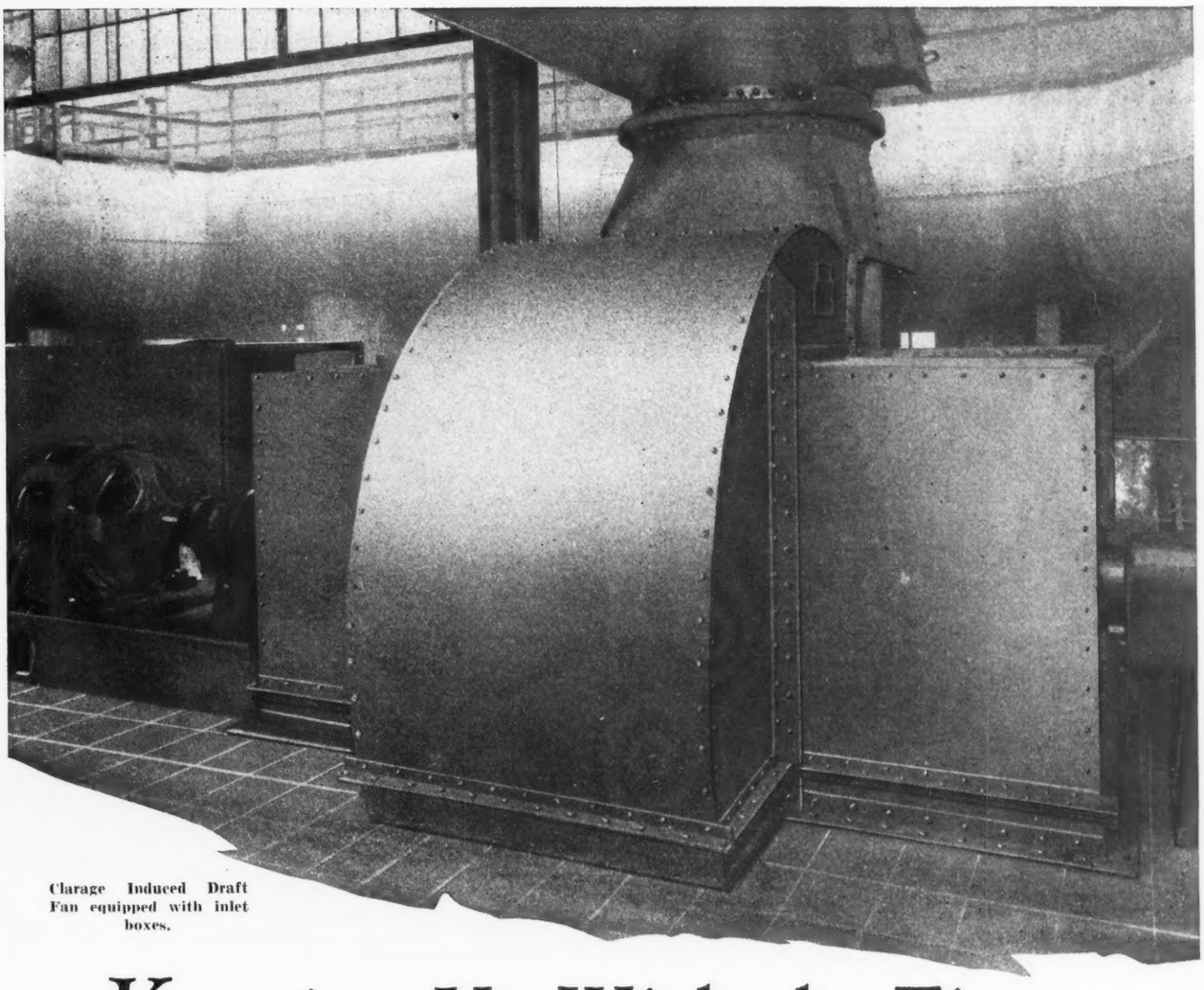
Grates, Stationary
Auburn (Ind.) Stoker Corp.
Babcock & Wilcox Co., N. Y.
CoKal Stoker Corp., Chicago
Combustion Eng. Corp., N. Y.
Cyclone Grate Bar Co., Buffalo
International Combustion Engineering Corp., N. Y.
Kelly Foundry & Machine Co. Goshen
McClave-Brooks Co., Scranton, Pa.
Marion (Ind.) Mach., Fdry. & Supply Co.
Neemes Fdry., Inc., Troy
Riley Stoker Corp., Worcester
Vogt Mach. Co., Henry, Louisville

Gratings
Tri-Lok Co., Pittsburgh

Grease
Vacuum Oil Co., N. Y.

Grease Extractors
Elliott Co., Jeannette, Pa.

Guns, Cement and Refractory
Cement Gun Co., Allentown



Clarage Induced Draft Fan equipped with inlet boxes.

Keeping Up With the Times

THE largest mechanical draft contract of this year 1928—one of the largest mechanical draft contracts of all time—was awarded to the Clarage Fan Company. While this fact is significant in itself, even more significant is the fact that the Clarage equipment furnished was designed to meet highly special requirements—static pressures to 12.5 inches; temperatures to 550 degrees F.

As power plant practice has advanced, Clarage has kept pace with it. As higher efficiencies, larger capacities and greater dependability have become necessary, Clarage has kept up with the times.

We have facilities to handle any problem in the field, small or large. Write for catalogs, or consult with Clarage engineers.

CLARAGE FAN COMPANY, Kalamazoo, Michigan, and Principal Cities

CLARAGE

Mechanical Draft Equipment

Headers, Welded
Midwest Piping & Supply Co., St. Louis

Heat Exchangers
Foster-Wheeler Corp., N. Y.
Wheeler Mfg. Co., C. H., Phila.

Heaters, Air
Air Preheater Co., N. Y.
Combustion Engineering Corp., N. Y.
Babcock & Wilcox Co., N. Y.
Foster Wheeler Corp., N. Y.
International Comoustion Engr. Corp., N. Y.
Prat-Daniel Corp., N. Y.
Sturtevant Co., B. F., Hyde Park

Heaters, Bleeder
Foster-Wheeler Corp., N. Y.

Heaters, Deaerating
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.
Hoppes Mfg. Co., Springfield, O.

Heaters, Domestic
Alberger Heater Co., Buffalo

Heaters, Feed Water
Alberger Heater Co., Buffalo
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., N. Y.
Griscom-Russell Co., N. Y.
Hoppes Mfg. Co., Springfield, O.
Neemes Fdry., Troy, N. Y.
Sturtevant Co., B. F., Hyde Park
Swartwout Co., Cleveland
Wheeler Mfg. Co., C. H., Phila.

Heaters, Hot Water Service
Foster-Wheeler Corp., N. Y.
Templeton Steam Trap Co., N. Y.

Heaters, Metering
Cochrane Corp., Phila.

Heaters, Oil
Alberger Heater Co., Buffalo
Coen Co., San Francisco
Foster-Wheeler Corp., N. Y.
Griscom-Russell Co., N. Y.
Hammel Oil Burning Equipt. Co. Providence

Heaters, Steam Stack
Cochrane Corp., Phila.

Heaters, Storage
Cochrane Corp., Phila.

Heaters, Unit
Sturtevant Co., B. F., Hyde Park

Heating and Ventilating Systems
Clarage Fan Co., Kalamazoo, Mich.
Prat-Daniel Corp., N. Y.
Sturtevant Co., B. F., Hyde Park

Hoists, Air
Ingersoll-Rand Co. N. Y.
Lagonda Mfg. Co., Springfield, Ohio

Hoist, Electric
Beaumont Co., R. H., Philadelphia

Hoists, Portable
Sullivan Machinery Co., Chicago

Hoists, Skip
Beaumont Co., R. H., Philadelphia

Hoists, Steam
Sullivan Machinery Co., Chicago

Hoppers, Coal and Ash
Allen, Sherman, Hoff Co., Phila
Beaumont Co., R. H., Philadelphia
Combustion Eng. Corp., N. Y.
International Combustion Engr. Corp., N. Y.
Link-Belt Co., Chicago

Hose, Rubber, For Air, Steam, Tube Cleaners, Water
Lagonda Mfg. Co., Springfield, Ohio
Quaker City Rubber Co., Wissinoming

Ice and Refrigerating Machinery
(See Refrigerating Machinery)

Idlers, Belt Conveyor
Dodge Mfg. Corp., Mishawaka

Idlers, Conveyor
Dodge Mfg. Corp., Mishawaka

Indicators, Combustion
Permutit Co., N. Y.

Indicators, Speed
Biddle, James G., Phila.
Scherr Co., Geo., N. Y.
Zernickow Co., O., N. Y.

Indicators, Steam Engine
Crosby Steam Gage & Valve Co., Boston

Indicators, Valve Position
Northern Equipment Co., Erie

Injectors
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Schutte & Koerting Co., Philadelphia

Instruments, Recording
Permutit Co., N. Y.

Insulating Materials
Banner Rock Products Co., Alexandria, Ind.
Celite Products Co., Los Angeles

Insulation Boiler
General Insulating Mfg. Co., Alexandria, Ind.

Insulation, Duct
General Insulating Mfg. Co., Alexandria, Ind.

Insulation, Heat
Banner Rock Products Co., Alexandria, Ind.

Insulation High Temperature
Celite Products Co., Los Angeles

Intercoolers
Foster-Wheeler Corp., N. Y.
Griscom-Russell Co., N. Y.

Keys, Machine, Self Fitting
Smith & Serrell, Newark

Lubricants
Vacuum Oil Co., N. Y.

Lubricators, Cylinder
Greene, Tweed & Co., N. Y.
Lunkenheimer Co., Cincinnati

Lubricators, Force Feed
Bowser & Co., S. F., Ft. Wayne
Greene, Tweed & Co., N. Y.

Machine Screws, Monel Metal
International Nickel Co., N. Y.
Machine Work, Special
Howard Iron Works, Buffalo

Machinery Built to order
Dodge Mfg. Corp., Miskawaka

Metal, Bearing
Magnolia Metal Co., N. Y.

Metal, Sheets, Rods, Castings
International Nickel Co., N. Y.

Meters, Air, Boiler, Flow, Gas, Oil, Water, Steam
Bailey Meter Co., Cleveland
Bowser & Co., S. F., Ft. Wayne
Cochrane Corp., Phila.
Elliott Co., Jeanette, Pa.
General Electric Co., Schenectady
Hoppes Mfg. Co., Springfield, O.
Republic Flow Meters Co. Chicago
Simplex Valve & Meter Co., Philadelphia
Yarnall-Waring Co., Phila.

Meters, Coal
Bailey Meter Co., Cleveland
Republic Flow Meters Co., Chicago

Meters, Electric
General Electric Co., Schenectady

Meters V-Notch
Bailey Meter Co., Cleveland
Cochrane Corp., Phila.
Hoppes Mfg. Co., Springfield, O.
Yarnall-Waring Co., Mermaid Ave., Phila.

Meters, Volumetric
Cochrane Corp., Phila.
Yarnall-Waring Co., Philadelphia

Meters, Weighing
Cochrane Corp., Phila.

Motor Generators
Elliott Co., Jeanette, Pa.

Motors, Electric
Allis-Chalmers Mfg. Co., Milwaukee
Elliott Co., Jeanette, Pa.
General Electric Co., Schenectady
Sturtevant Co., B. F., Hyde Park

Motors, Synchronous
Elliott Co., Jeanette, Pa.

Motors, Water
Roto Co., Newark

Nickel, Sheets, Rod & Castings
American Mond Nickel Co., Pittsburgh
International Nickel Co., N. Y.

Oil and Grease Cups
Lunkenheimer Co., Cincinnati

Oil, Lubricating
Dearborn Chemical Co., Chicago
Vacuum Oil Co., N. Y.

Oil Purifiers
Burt Mfg. Co., Akron

Oil, Reclaimers, Centrifugal
Bowser & Co., S. F., Ft. Wayne
De Laval Separator Co., N. Y.

Oil Reservoirs
Bowser & Co., S. F., Ft. Wayne
Burt Mfg. Co., Akron

Oil Storage Equipment
Bowser & Co., S. F., Fort Wayne, Ind.

Oilers Sight Feed and Multiple
Bowser & Co., S. F., Ft. Wayne
Nugent & Co., Wm. W., Chicago

Oiling Devices and Systems
Burt Mfg. Co., Akron
Nugent & Co., Wm. W., Chicago

Packing, Asbestos
Garlock Packing Co., Palmyra, N. Y
Greene, Tweed & Co., N. Y.
Keasbey & Mattison Co., Ambler

Packing, Condenser, Tube
Crane Packing Co., Chicago
Garlock Packing Co., Palmyra

Packing, Cylinder, Hydraulic, Piston, Rod, Sheet, Valve Stem, Pump Valve
Alfit Packing Co., N. Y.
Chesterton Co., A. W., Boston
Conneaut Packing Co., Conneaut, O.
Crane Packing Co., Chicago
Garlock Packing Co., Palmyra, N. Y
Greene, Tweed & Co., N. Y.
Quaker City Rubber Co., Wissinoming

Packing, Flax
Chesterton Co., A. W., Boston
Garlock Packing Co., Palmyra, N. Y.
Greene, Tweed & Co., N. Y.

Packing, Metallic
Alfit Packing Co., N. Y.
Conneaut Packing Co., Conneaut, O.
Crane Packing Co., Chicago
France Packing Co., Philadelphia
Garlock Packing Co., Palmyra, N. Y

Packing, Metallic Condenser
Crane Packing Co., Chicago

Packing Metallic Flexible
Crane Packing Co., Chicago
France Packing Co., Philadelphia
Garlock Packing Co., Palmyra, N. Y.

Packing, Plastic, Metallic
Alfit Packing Co., N. Y.
Conneaut Packing Co., Conneaut, O.
Garlock Packing Co., Palmyra

Paints, Rust Proofing
Dearborn Chemical Co., Chicago

Pipe
Byers Co., A. M., Pittsburgh
Grinnell Co., Providence
Kellogg Co., M. W., N. Y.
Power Piping Co., Pittsburgh

Pipe Bending
American Pipe Bending Mach. Co., Boston
Grinnell Co., Providence
Kellogg Co., M. W., N. Y.
Midwest Piping & Supply Co., St. Louis
Power Piping Co., Pittsburgh
Pipe, Brass & Copper
Foster-Wheeler Corp., N. Y.

Pipe Coils
Abendroth & Root Mfg. Co., N. Y.
Griscom-Russell Co., N. Y.
Midwest Piping & Supply Co., St. Louis

Pipe Cutting and Threading Machines
Trimont Mfg. Co., Roxbury
Toledo (Ohio) Pipe Threading Mach. Co.

Pipe Fittings
Grinnell Co., Providence
Jefferson Union Co., Lexington.
Kellogg Co., M. W., N. Y.
Pittsburgh (Pa.) Piping & Equip. Co.
Power Piping Co., Pittsburgh

Pipe Hangers and Supports
Midwest Piping & Supply Co., St. Louis

Pipe Spiral, Riveted
Abendroth & Root Mfg. Co., N. Y.

Pipe, Welded & Seamless
Kellogg Co., M. W., N. Y.

Pipe, Wrought Steel
Byers Co., A. M., Pittsburgh

Piping Contractors
Baker Co., R. H., Cambridge
Grinnell Co., Providence
Kellogg Co., M. W., N. Y.
Pittsburgh (Pa.) Piping & Equip. Co.
Pittsburgh (Pa.) Valve & Fdry. & Const. Co.
Power Piping Co., Pittsburgh

Piping, Fabricators
Kellogg Co., M. W., N. Y.

Piping, High Pressure
Baker Co., R. H., Cambridge
Byers Co., A. M., Pittsburgh
Kellogg Co., M. W., N. Y.
Pittsburgh (Pa.) Valve & Fdry. & Const. Co.
Pittsburgh (Pa.) Piping & Equip. Co.
Power Piping Co., Pittsburgh

Pneumatic Tools
Ingersoll-Rand Co., N. Y.

Power Transmission Machinery
Allis-Chalmers Mfg. Co., Milwaukee
Dodge Mfg. Corp., Miskawaka
Link-Belt Co., Chicago

Pre-Heaters, Air
Air-Preheater Corp., N. Y.
Buffalo Forge Co., Buffalo
Combustion Engineering Corp., N. Y.
Foster Wheeler Corp., N. Y.
Green Fuel Economizer Co., Beacon
International Combustion Engineering Corp., N. Y.
Prat-Daniel Corp., N. Y.
Sturtevant Co., B. F., Hyde Park

Pulleys
Dodge Mfg. Corp., Mishawaka
Greene, Tweed & Co., N. Y.

Pulverized Coal Equipment
Combustion Engineering Corp., N. Y.
Foster Wheeler Corp., N. Y.
Fuller Lehigh, Fullerton
International Combustion Engr. Corp., N. Y.
Peabody Engineering Corp., N. Y.
Riley Stoker Corp., Worcester
Strong-Scott Mfg. Co., Minneapolis
Pump Lines
American Mond Nickel Co., Pittsburgh

Pump Liners, Monel Metal
International Nickel Co., N. Y.

Pump Liners, Nickel
American Mond Nickel Co., Pittsburgh

Pump Rods, Monel Metal
International Nickel Co., N. Y.

Pump Rods, Nickel
American Mond Nickel Co., Pittsburgh

Pumps, Air
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., N. Y.
Wheeler Mfg. Co., C. H., Phila.

Pumps, Air Lift
Ingersoll-Rand Co. N. Y.
Pennsylvania Pump & Compressor Co., Easton, Pa.

Pumps, Boiler Feed
Cameron Steam Pump Works A. S., N. Y. (Ingersoll-Rand Co.)
Ingersoll-Rand Co., N. Y. (A. S. Cameron Steam Pump Works)

Pumps, Centrifugal
Allis-Chalmers Mfg. Co., Milwaukee
Buffalo Steam Pump Co., Buffalo
Cameron Steam Pump Works, A. S., N. Y. (Ingersoll-Rand Co.)
De Laval Steam Turbine Co., Trenton, N. J.
Economy Pump Mchy. Co., Chicago
Elliott Co., Jeannette, Pa.
Foster-Wheeler Corp., N. Y.
Frederick (Md.) Iron & Steel Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Wks.), N. Y.
Lecourtenay Co., Newark, N. J.
Manistee (Mich.) Iron Works Co.
Moore Steam Turbine Corp., Wellsville, N. Y.
Nash Engineering So., So. Norwalk
Pennsylvania Pump & Compressor Co., Easton, Pa.
Terry Steam Turbine Co., Hartford
Westco-Chippewa Pump Co., Davenport, Ia.
Wheeler [illegible] Co., C. H., Phila.

Pumps, Condensate
Cameron Steam Pump Works, A. S., N. Y. (Ingersoll-Rand Co.)
Economy Pump Mchy. Co., Chicago
Elliott Co., Jeannette, Pa.
Ingersoll-Rand Co. (Cameron Steam Pump Wks., A. S.), N. Y.

Pumps, Deep Well
Economy Pump Mchy. Co., Chicago
Westco-Chippewa Pump Co., Davenport, Iowa

Pumps, Gear
Schutte & Koerting Co., Philadelphia

Pumps, Mine
Economy Pump Mchy. Co., Chicago

Pumps, Oil
Coen Co., San Francisco
Economy Pump Mchy. Co., Chicago
Hammel Oil Burning Equipt. Co. Providence
Lunkenheimer Co., Cincinnati

Pumps, Power
Economy Pump Mchy. Co., Chicago
Gardner-Denver Co., Quincy
Platt Iron Works, Dayton, Ohio
Westco-Chippewa Pump Co., Davenport, Ia.

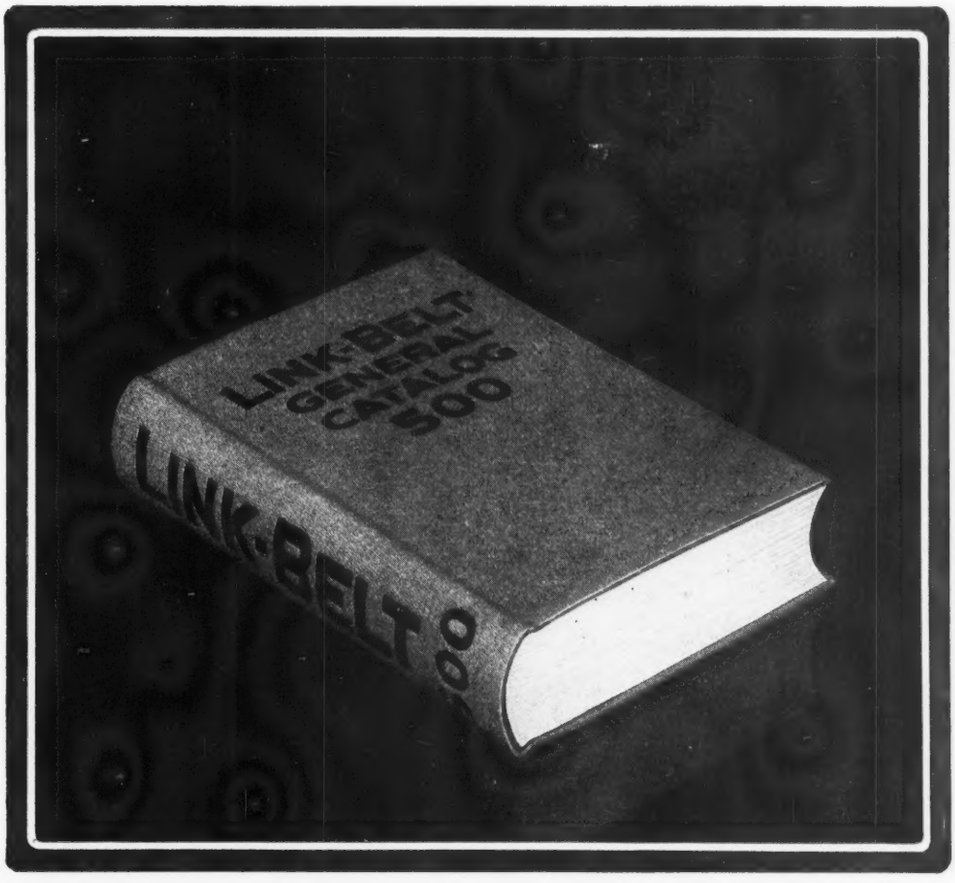
Pumps, Pulverized Coal
Fuller-Lehigh Co., Fullerton

Pumps, Reciprocating
Allis-Chalmers Mfg. Co., Milwaukee
Buffalo (N. Y.) Steam Pump Co.
Cameron Steam Pump Works, A. S., N. Y. (Ingersoll-Rand Co.)
Gardner-Denver Co., Quincy
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Wks.), N. Y.
Manistee (Mich.) Iron Works Co.
Platt Iron Works, Dayton
Westco-Chippewa Pump Co., Davenport, Ia.

Pumps, Rotary
Bowser & Co., S. F., Ft. Wayne
Wheeler Mfg. Co., C. H., Phila.

Pumps, Sump
Cameron Steam Pump Works, A. S., N. Y. (Ingersoll-Rand Co.)

Chains—Wheels—Buckets
Conveyors for Industry



TO those who can use this catalog in purchasing Link-Belt equipment, or in designing materials-handling equipment, or who can profit otherwise through its use—a copy will be sent gladly on request. Address our nearest office on your business stationery.

1088-pages on Chains, Wheels, Elevating, Conveying, and Power Transmission Machinery and Accessories —the most complete engineering data book and catalog we have ever published.

3594

LINK-BELT COMPANY

Leading Manufacturers of Elevating, Conveying, and Power Transmission Chains and Machinery

CHICAGO, 300 W. Pershing Rd. INDIANAPOLIS, 200 S. Belmont Ave. PHILADELPHIA, 2045 W. Hunting Park Ave. SAN FRANCISCO, 19th & Harrison Sts.

Ashland, Ky. - - - 100 W. Winchester Ave.
Atlanta - - - - 511 Haas-Howell Bldg.
Baltimore, Md., R. 800 Maryland Trust Bldg.
Birmingham, Ala. - 229 Brown-Marx Bldg.
Boston - - - - - - 1103-4 Statler Bldg.
Buffalo - - - - - 554 Ellicott Square
Cleveland - - - - - 527 Rockefeller Bldg.
Dallas, Texas 1101 Mercantile Bank Bldg.
Denver - - - - - - 520 Boston Bldg.
Detroit - - - - - 5938 Linsdale Ave.
Grand Rapids - 536 Michigan Trust Bldg.
Huntington, W. Va., Robson-Prichard Bldg.
Kansas City, Mo., R. 436, 1002 Baltimore Ave.
Louisville, Ky. - - - - 349 Starks Bldg.
Los Angeles - - - 361-369 S. Anderson St.
Milwaukee - Room 1403, 425 E. Water St.
New Orleans - - - - 621 S. Peters St.
New York - - - 2676 Woolworth Bldg.
Wilkes-Barre, 826 Second National Bank Bldg.
Oakland, Calif. - - - - - 526 Third St.
Pittsburgh - - - - - - 335 Fifth Ave.
Portland, Ore. - - - - - 67 Front St.
Seattle - - - - - - - 820 First Ave., S.
St. Louis - - - - - - - 3638 Olive St.
Utica, N. Y. - - - - - 131 Genesee St.

H. W. CALDWELL & SON CO.:—Chicago, 2410 West 18th St.; New York, 2676 Woolworth Bldg. In Canada—LINK-BELT LIMITED—Toronto; Montreal; Elmira, Ont.

LINK-BELT

Economy Pump Mchy. Co., Chicago
Elliott Co., Jeannette, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Wks.), N. Y.
Sullivan Machinery Co., Chicago
Wheeler Mfg. Co., C. H., Phila.

Pumps, Underwriters, Centrifugal
Economy Pump Mchy. Co., Chicago

Pumps, Vacuum
Economy Pump Mchy. Co., Chicago
Foster-Wheeler Corp., N. Y.
Ingersoll-Rand Co. N. Y.

Purifiers, Feed Water
Cochrane Corp., Phila., Pa.
Griscom-Russell Co., N. Y.
Hagan Corp., Pittsburgh
Hoppes Mfg. Co., Springfield, O.
Permutit Co., N. Y.
Yarnall-Waring Co., Phila., Pa.

Purifiers, Steam
Andrews-Bradshaw Co., (Division of Blaw-Knox Co.) Pittsburgh
Hagan Corp., Pittsburgh
Marley Co., Kansas City

Pyrometers
Bristol Co., Waterbury
Republic Flow Meters Co., Chicago
Taylor Instrument Co.'s, Rochester

Recorders, Draft
Republic Flow Meters Co., Chicago

Recorders, Gas Density
Permutit Co., N. Y.

Recorders, Pressure
American Schaeffer & Budenberg Corp., Div. Consolidated Ashcroft Hancock Corp., Brooklyn
Crosby Steam Gage & Valve Co., Boston
Taylor Instrument Co.'s, Rochester

Recorders, Vacuum
Crosby Steam Gage & Valve Co., Boston

Refractories
Bartley Crucible Co., Jonathan, Trenton
General Refractories Co., Philadelphia
King Refractories Co., Buffalo
Lavino & Co., E. J., Philadelphia
McLeod & Henry Co., Troy
Obermayer Co., S. Chicago
Plibrico Jointless Fire Brick Co., Chicago

Refractory Placing Machines
Cement Gun Co., Allentown

Refractory, Shapes, Special
Babcock & Wilcox Co., N. Y.

Refrigerating Machinery
De La Vergne Machine Co., N. Y.
Ingersoll-Rand Co., N. Y.
Vogt Machine Co., Henry, Louisville

Regulators, Blower
McClave-Brooks Co., Scranton, Pa.

Regulators, Damper, Draft and Fan
Atlas Valve Co., Newark
Hagan Corp., Pittsburgh
Smoot Engr. Corp., N. Y.

Regulators, Feed Water
Atlas Valve Co., Newark
Mason Regulator Co., Boston
Northern Equipment Co., Erie

Regulators, Gas
Davis Regulator Co., G. M., Chicago

Regulators, Pressure
American Radiator Co., Chicago
Chaplin-Fulton Mfg. Co., Pittsburgh
Crane Co., Chicago
Davis Regulator Co., G. M., Chicago
Mason Regulator Co., Boston
Northern Equipment Co., Erie
Taylor Instrument Co.'s, Rochester

Regulators, Pump
Mason Regulator Co., Boston
Northern Equipment Co., Erie

Regulators, Temperature
American Radiator Co., Chicago
American Schaeffer & Budenberg Corp., iv. Consolidated Ashcroft Hancock Corp., Brooklyn

Rheostats
General Electric Co., Schenectady

Rings, Weldless, Nickel
American Mond Nickel Co., Pittsburgh

Rings, Weldless Monel Metal
International Nickel Co., N. Y.

Rods, Monel Metal
International Nickel Co., N. Y.

Rods, Nickel
American Mond Nickel Co., Pittsburgh

Rope Transmission
American Steel & Wire Co., Chicago
Hunt Co., C. W., West New Brighton, N. Y.

Rubber Goods
Quaker City Rubber Co., Wissinoming

Rust Preventatives
Dearborn Chemical Co., Chicago

Safety Steps, Steel
Hendrick Mfg. Co., Carbondale

Scale Removers, Boiler Tube
General Specialty Co., Buffalo
Lagonda Mfg. Co., Springfield, O.
Roto Co., Newark

Screens, Shaking and Revolving
Gifford Wood Co., Hudson

Screens, Water Intake
General Electric Co., Schenectady

Second-Hand Equipment
(See Searchlight Section)
Bolling & Co., Stewart
Commonwealth Edison Co.
Davis, J. F.
Fuerst-Friedman Co., The
Kehoe Machinery Co., Robt. P.
Land, L. J.
Nashville Industrial Corpn.
O'Brien Mchy. Co.
Power Plant & Equipment Co.
Randle Machy. Co.
Sachsenmaier, Geo.
Stewart & Co., Paul

Separators, Air, Ammonia, Oil, Steam
Andrews-Bradshaw Co., (Division of Blaw-Knox Co.) Pittsburgh
Cochrane Corp., Phila.
Crane Co., Chicago
De Laval Separator Co., N. Y.
Elliott Co., Jeannette
Griscom-Russell Co., N. Y.
Hagan Corp., Pittsburgh
Hoppes Mfg. Co., Springfield, O.
Marley Co., Kansas City
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Swartwout Co., Cleveland
Templeton Steam Trap Co., N. Y.

Separators, Receiver
Cochrane Corp., Phila.

Sheets, Nickel
American Mond Nickel Co., Pittsburgh

Sheets, Monel Metal
International Nickel Co., N. Y.

Sodium Aluminate
National Aluminate Co., Chicago

Speed Reducers
Bowser & Co., S. F., Ft. Wayne
De Laval Steam Turbine Co., Trenton, N. J.
Dodge Mfg. Corp., Mishawaka
Nuttall Co., R. D., Pittsburgh
Philadelphia (Pa.) Gear Works

Spray Nozzles
(See Cooling Plants and Ponds)

Stacks, Brick, Radial Brick
Custodis Chimney Constr. Co., Alphons, N. Y.
Heinicke, H. R., Indianapolis
Kellogg Co., M. W., N. Y.
Rust Engineering Co., Pittsburgh

Stacks, Concrete
Custodis Chimney Construction Co., Alphons, N. Y.
Kellogg Co., M. W., N. Y.
Rust Engineering Co., Pittsburgh

Stacks, Metal
Coatsville (Pa.) Boiler Works
Connery & Co., Philadelphia
Hedges-Walsh & Weidner Boiler Co., Chattanooga
Heine Boiler Co., N. Y.
Prat-Daniel Corp., N. Y.
Union Iron Works, Erie, Pa.

Steel Plate Work
Heat Transfer Products, N. Y.
Murray Iron Wks. Co., Burlington
Union Iron Wks., Erie, Pa.

Stokers, Chain and Traveling Grate
Babcock & Wilcox Co., N. Y.
Combustion Engineering Corp., N. Y.
Illinois Stoker Co., Alton
International Combustion Engineering Corp., N. Y.
Laclede Stoker Co., St. Louis, Mo.
McClave-Brooks Co., Scranton, Pa.
Riley Stoker Corp., Worcester

Stokers, Hand Operated
Auburn Stoker Corp., Auburn, Ind.
CoKal Stoker Corp., Chicago
Combustion Engineering Corp., N. Y.
International Combustion Engineering Corp., N. Y.
Flynn & Emrich Co., Baltimore
McClave-Brooks Co., Scranton, Pa.
Marion (Ind.) Mach., Fdry. & Supply Co.

Stokers, Mechanical
American Engineering Co., Phila.
Auburn Stoker Corp., Auburn, Ind.
Babcock & Wilcox Co., N. Y.
CoKal Stoker Corp., Chicago
Combustion Engineering Corp., N. Y.
Detroit (Mich.) Stoker Co.
Flynn & Emrich Co., Baltimore
Illinois Stoker Co., Alton
International Combustion Engineering Corp., N. Y.
McClave-Brooks Co., Scranton
Riley Stoker Corp., Worcester
Sturtevant Co., B. F., Hyde Park

Stops, Engine
Gas Combustion Co., Pittsburgh

Strainers, Oil, Water
Coen Co., San Francisco
Elliott Co., Jeannette, Pa.
Griscom-Russell Co., N. Y.
Sarco Co., Inc., N. Y.

Strainers, Pump Suction
Elliott Co., Jeannette, Pa.

Superheaters
Babcock & Wilcox Co., N. Y.
Foster Wheeler Corp., N. Y.
Marley Co., Kansas City, Mo.

Switchboards
General Electric Co., Schenectady

Switches & Circuit Breakers, Electric
General Electric Co., Schenectady

Tachometers
American Schaeffer & Budenberg Corp., Div. Consolidated Ashcroft Hancock Corp., Brooklyn
Biddle, James G., Phila.
Bristol Co., Waterbury
Scherr Co., Geo., N. Y.
Zernickow Co., O., N. Y.

Tanks
Cochrane Corp., Phila.
Connery & Co., Philadelphia
Hedges-Walsh & Weidner Boiler Co., Chattanooga
Heine Boiler Co., N. Y.
Union Iron Works, Erie

Tanks, Copper
Hercules Float Wks., Springfield.

Tanks, Portable Oil
Bowser & Co., S. F., Ft. Wayne

Thermometers, Controlling, Indicating, Recording
Bailey Meter Co., Cleveland
Bristol Co., Waterbury
Taylor Instrument Co.'s, Rochester

Thermometers, Flue Gas
American Schaeffer & Budenberg Corp., Div. Consolidated Ashcroft Hancock Corp., Brooklyn
Bailey Meter Co., Cleveland

Transformers
Allis-Chalmers Mfg. Co., Milwaukee
General Electric Co., Schenectady

Transmission Machinery
(See Power Transmission Mach.)

Traps, Air, Grease, Non Return, Return, Radiator, Steam, Vacuum
American Schaeffer & Budenberg Corp., Div. Consolidated Ashcroft Hancock Corp., Brooklyn
Andrews-Bradshaw Co., Pittsburgh
Armstrong Mach. Works, Three Rivers, Mich.
Cochrane Corp., Phila.
Crane Co., Chicago
Davis Regulator Co., G. M., Chicago
Ellis Drier Co., Chicago
Golden Anderson Valve Co., Specialty Co., Pittsburgh
Morehead Mfg. Co., Detroit
Nason Mfg. Co., N. Y.
Nicholson & Co., W. H., Wilkes-Barre
Powers Regulator Co., Chicago
Sarco Co., No., N. Y.
Sterling Engr. & Mfg. Corp., Boston
Swartwout Co., Cleveland
Templeton Steam Trap Co., N. Y.
Templeton Mfg. Co., Boston
Trerice Co., H. O., Detroit

Tube Cleaners, Boiler
Chesterton Co., A. W., Boston
General Specialty Co., Buffalo
Lagonda Mfg. Co., Springfield, Ohio
Roto Co., Newark

Tube Cleaners Condenser
Garlock Packing Co., Palmyra
Lagonda Mfg. Co., Springfield, Ohio
Roto Co., Newark

Tube Cutters
Lagonda Mfg. Co., Springfield, Ohio

Tubes, Boiler
Boiler Tube Co. of America, Pittsburgh
Standard Wire & Tube Co., Mineral Ridge, O.
Tyler Tube & Pipe Co., Washington, Pa.

Tubes, Boiler, Charcoal Iron
Tyler Tube & Pipe Co., Washington

Tubes, Boiler, Lap Welded
Tyler Tube & Pipe Co., Washington

Tubing
Boiler Tube Co. of America, Pittsburgh

Tubing, Monel Metal
International Nickel Co., N. Y.

Tubing, Nickel
American Mond Nickel Co., Pittsburgh

Turbines, Steam
Allis-Chalmers Mfg. Co., Milwaukee
Coppus Engineering Corp., Worcester
De Laval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
General Electric Co., Schenectady
Moore Steam Turbine Corp., Wellsville, N. Y.
Murray Iron Wks. Co., Burlington
Sturtevant Co., B. F., Hyde Park
Terry Steam Turbine Co., Hartford

Turbines, Water
Allis-Chalmers Mfg. Co., Milwaukee

Turbo Generators
Elliott Co., Jeannette, Pa.
Terry Steam Turbine Co., Hartford

Unions and Union Fittings
Crane Co., Chicago
Dart Mfg. Co., E. M., Providence
Jefferson Union Co., Lexington

Valve Control, Electric
Pittsburgh (Pa.) Valve & Fdry. & Const. Co.

Valve Disk
Garlock Packing Co., Palmyra N. Y.

Valve Reseating Machine
Leavitt Mach. Co., Orange, Mass.

Valves, Altitude
Golden Anderson Valve Specialty Co., Pittsburgh

Valves, Ammonia
Consolidated Ashcroft Hancock Co., Inc., N. Y.

Valves, Angle
Consolidated Ashcroft Hancock Co., Inc., N. Y.

Valves, Automatic Air
Simplex Valve & Meter Co., Philadelphia
Sterling Engr. & Mfg. Corp., Boston
Templeton Mfg. Co., Boston

Valves, Automatic Cutoff
Elliott Co., Jeannette, Pa.
Golden Anderson Valve Specialty Co., Pittsburgh

Valves, Back Pressure
Cochrane Corp., Phila.
Davis Regulator Co., G. M., Chicago

Valves Balanced
Davis Regulator Co., G. M., Chicago
Northern Equipment Co., Erie
Swartwout Co., Cleveland

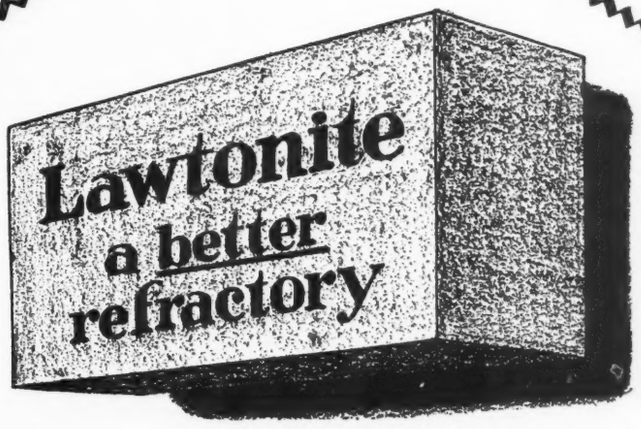
Valves, Blowoff
Consolidated Ashcroft Hancock Co. Inc., N. Y.
Crane Co., Chicago
Crosby Steam Gage & Valve Co., Boston
Eckenroth Valve & Mfg. Co., Phila.
Elliott Co., Jeannette, Pa.
Homestead (Pa.) Valve Mfg. Co.
Lunkenheimer Co., Cincinnati
Templeton Steam Trap Co., N. Y.
Williams Valve Co., D. T., Cincinnati
Yarnall-Waring Co., Phila.

Valves, Brass and Iron Body
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Crane Co., Chicago
Golden Anderson Valve Specialty Co., Pittsburgh
Homestead (Pa.) Valve Mfg. Co.
Kennedy Valve Mfg. Co., Elmira
Lunkenheimer Co., Cincinnati
Pittsburgh (Pa.) Piping & Equip. Co.
Walworth Co., Boston
Williams Valve Co., D. T., Cincinnati

Valves, Bypass
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Northern Equipment Co., Erie

Valves, Check
Cochrane Corp., Phila.
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Crane Co., Chicago
Davis Regulator Co., G. M., Chicago
Golden Anderson Valve Specialty Co., Pittsburgh
Greene, Tweed & Co., N. Y.
Kennedy Valve Mfg. Co., Elmira
Lunkenheimer Co., Cincinnati

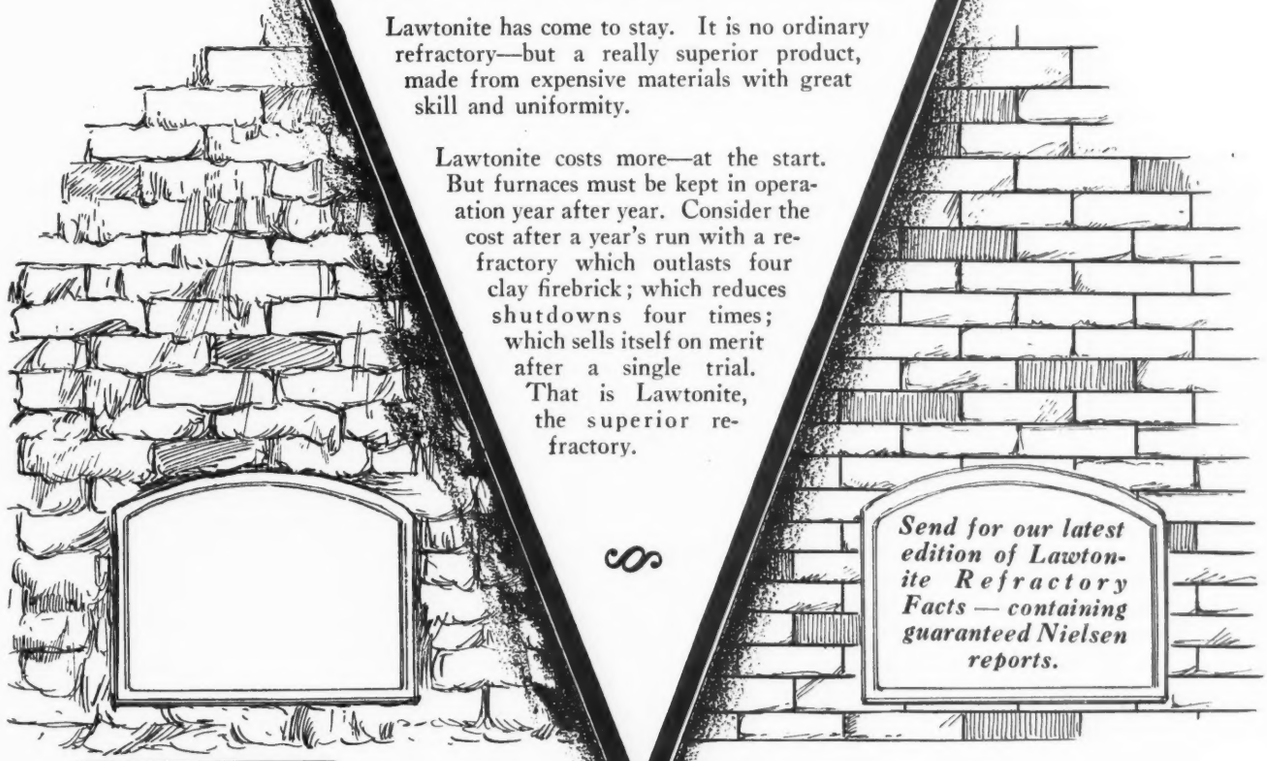
WASTE or PROFIT



NOW is the time to decide! Will it be the old story of slag-scored, worn out firebrick, or will your furnaces be fit and solid after a long run with forced fires and high boiler ratings.

Lawtonite has come to stay. It is no ordinary refractory—but a really superior product, made from expensive materials with great skill and uniformity.

Lawtonite costs more—at the start. But furnaces must be kept in operation year after year. Consider the cost after a year's run with a refractory which outlasts four clay firebrick; which reduces shutdowns four times; which sells itself on merit after a single trial. That is Lawtonite, the superior refractory.



Send for our latest edition of Lawtonite Refractory Facts — containing guaranteed Nielsen reports.

LAWTONITE
GRAPHITE AND CLAY
PRODUCTS
TRADE MARK
REG. U.S. PAT OFF.

Jonathan Bartley Crucible Co.

Manufacturers to several of the largest furnace and combustion engineering companies.

Trenton, N. J.

BRANCHES:

Francis Wagner, Martin Bldg., El Paso, Tex.
D. M. Hamilton, 3201 Lawrence Ave., Detroit, Mich.
E. D. Bullard Co., 275 8th St., San Francisco, Calif.
W. T. Withers Supply Co., 962 Atlanta Trust Bldg., Atlanta, Ga.
A. C. Moulton, 206 S. W. Temple, Salt Lake City, Utah

Valves, Electrically Operated
Golden-Anderson Valve Specialty Co., Pittsburgh
Pittsburgh (Pa.) Valve & Fdry. & Const. Co.

Valves, Exhaust Relief
Davis Regulator Co., G. M., Chicago
Wheeler Mfg. Co., C. H., Phila.

Valves, Float
Cochrane Corp., Phila.
Davis Regulator Co., G. M., Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh
Northern Equipment Co , Erie
Yarnall-Waring Co., Phila.

Valves, Gate
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Crane Co., Chicago
Greene, Tweed & Co., N. Y.
Lunkenheimer Co., Cincinnati
Kennedy Valve Mfg. Co., Elmira
Pittsburgh (Pa.) Piping & Equip Co.
Pittsburgh (Pa.) Valve & Fdry. & Const. Co.
Wheeler Mfg. Co., C. H., Phila.
Williams Valve Co., D. T., Cincinnati

Valves, Globe
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Crane Co., Chicago
Crosby Steam Gage & Valve Co., Boston
Golden-Anderson Valve Specialty Co., Pittsburgh
Kennedy Valve Mfg. Co., Elmira
Lunkenheimer Co., Cincinnati
Williams Valve Co., D. T., Cincinnati

Valves, Hydraulic
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Homestead (Pa.) Valve Mfg Co.
Kennedy Valve Mfg. Co., Elmira
Swartwout Co., Cleveland
Vogt Machine Co., Henry, Louisville
Williams Valve Co., D. T., Cincinnati
Yarnall-Waring Co., Phila.

Valves, Monel Metal
International Nickel Co., N. Y.

Valves, Non-Return Stop
Elliott C., Jeannette, Pa.
Golden-Anderson Valve Specialty Co., Pittsburgh

Valves, Pop, Safety
Consolidated Ashcroft Hancock Co., Inc., N. Y.

Valves, Pump Rubber
Garlock Packing Co., Palmyra, N. Y.
Jenkins Bros., N. Y.

Valves, Reducing
Davis Regulator Co., G. M., Chicago
Golden Anderson Valve Specialty Co., Pittsburgh
Mason Regulator Co., Boston
Northern Equipment Co., Erie
Schutte & Koerting Co., Philadelphia
Swartwout Co., Cleveland
Templeton Steam Trap Co., N. Y.

Valves, Regrinding
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Williams Valve Co., D. T., Cincinnati

Valves, Regulating
Atlas Valve Co., Newark
Bristol Co., Waterbury
Golden-Anderson Valve Specialty Co., Pittsburgh
Mason Regulator Co., Boston
Northern Equipment Co., Erie
Pittsburgh (Pa.) Valve & Fdry. & Const. Co.
Simplex Valve & Meter Co., Philadelphia
Swartwout Co., Cleveland

Valves, Relief
American Schaeffer & Budenberg Corp., Div. Consolidated Ashcroft Hancock Corp., Brooklyn
Cochrane Corp., Phila.
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Golden-Anderson Valve Specialty Co., Pittsburgh
Northern Equipment Co., Erie
Pittsburgh (Pa.) Valve & Fdry. & Const. Co.
Swartwout Co., Cleveland

Valves, Safety
American Schaeffer & Budenberg Corp., Div. Consolidated Ashcroft Hancock Corp., Brooklyn
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Crosby Steam Gage & Valve Co., Boston
Golden-Anderson Valve Specialty Co., Pittsburgh
Lunkenheimer Co., Cincinnati

Valves, Steel
Lunkenheimer Co., Cincinnati

Valves, Stop
Golden-Anderson Valve Specialty Co., Pittsburgh

Valves, Stop Check
Elliott Co., Jeannette, Pa.
Schutte & Koerting Co., Philadelphia

Valves, Superheated Steam
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Golden-Anderson Valve Specialty Co., Pittsburgh
Pittsburgh (Pa.) Valve & Fdry. & Const. Co.
Vogt Machine Co., Henry, Louisville

Valves, Two, Three and Four-Way
Nicholson & Co., W. H., Wilkes-Barre, Pa.

Valves, Throttle
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Golden-Anderson Valve Specialty Co., Pittsburgh, Pa.
Schutte-Koerting Co., Phila.

Valves, Vacuum
Sarco Co., N. Y.

Ventilators
Burt Mfg. Co., Akron
Sturtevant Co., B. F., Hyde Park

Vises
Toledo (Ohio) Pipe Threading Machine Co.

Waterbacks, High & Low Pressure
Foster-Wheeler Corp., N. Y.
McClave-Brooks Co., Scranton

Water, Columns
Golden-Anderson Valve Specialty Co., Pittsburgh
Nuttall Co., R. D., Pittsburgh
Water Columns, Alarm Type
Yarnall-Waring Co., Philadelphia

Waterproofing
Celite Products Co., Los Angeles

Water Purifying Apparatus
Cochrane Corp., Phila.
Griscom-Russell Co., N. Y.
Hagan Corp., Pittsburgh
Permutit Co., N. Y.

Water Softening Apparatus
Cochrane Corp., Phila.
National Aluminate Co., Chicago
Permutit Co., N. Y.

Water Testing Equipment
Griscom-Russell Co., N. Y.
National Aluminate Co., Chicago

Water Treatment, Feed
Dearborn Chemical Co., Chicago
Permutit Co., N. Y.

Water Wheels
Allis-Chalmers Mfg. Co., Milwaukee

Wire and Rods, Welding
American Steel & Wire Co., Chicago

Wire Cloth & Screen, Nickel
International Nickel Co., N. Y.

Wire, Electric
American Steel & Wire Co., Chicago

Wrenches
Greene, Tweed & Co., N. Y.
Trimont Mfg. Co., Roxbury

Wrenches, Pipe
Trimont Mfg. Co., Roxbury

This index is published as a convenience to the reader. Every care is taken to make it accurate, but *Power* assumes no responsibility for errors or omissions. For alphabetical index see last page

3,200,000
POUNDS
PRESSURE
—gives Tri-Lok Grating and Tread a super-strength and rigidity unrivaled by any other type of ventilated flooring. No rivets, bolts or welds are used and for this reason Tri-Lok has none of the inherent weaknesses found in ordinary steel gratings.
Write for detailed information.
THE TRI-LOK COMPANY
5555 BUTLER STREET
PITTSBURGH, PENNA.
TRI-LOK
PAT.
TRADE MARK REG.
"KING OF THE WALK"

BEAUMONT Cable Drag Scraper
for Coal Storage
Compact — Dependable — Durable
Send for Catalog
R·H·BEAUMONT CO
322 Arch St., Philadelphia

Hercules Seamless Copper Floats Last Indefinitely
Don't buy floats that wear out in a short time and have to be replaced. Hercules Floats, because of their remarkable endurance, eliminate constant renewal and repair expense.
Write for prices and details
HERCULES FLOAT WORKS
200 Franklin St., Springfield, Mass.

Bigelow-Liptak Corporation
FURNACE ARCH and WALL CONSTRUCTION
5057 WOODWARD AVENUE
DETROIT, MICHIGAN

Your Name
in this space in all issues where larger display space is not used backs up your advertising campaign and keeps your name in the classified section.

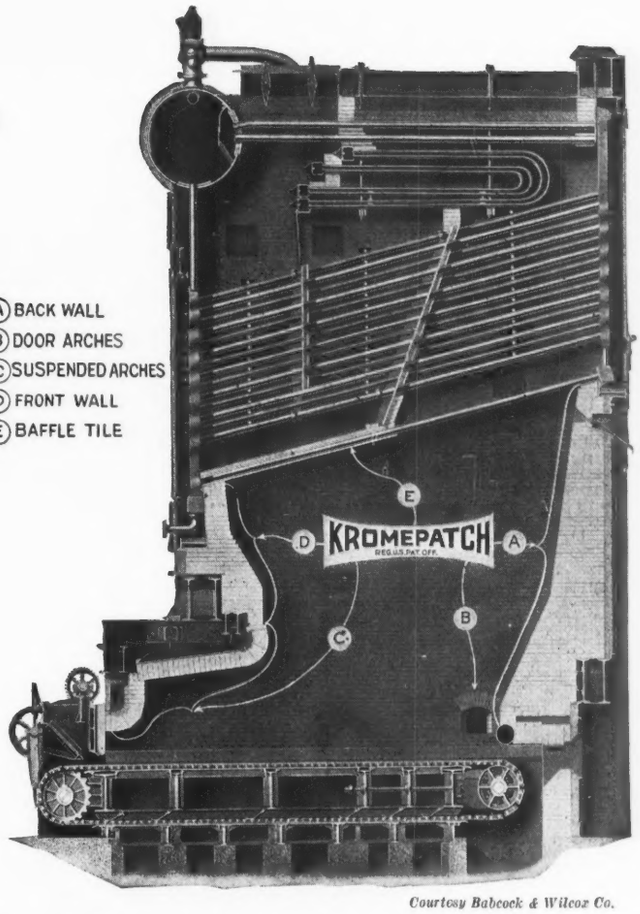
Economical Applications of

KROMEPATCH

REG. U.S. PAT. OFF.

THE DRY
CHROME ORE CEMENT

Recommended by Lavino Engineers



Courtesy Babcock & Wilcox Co.

for B. & W. CROSS DRUM BOILERS

Bulletin 10-3-A tells why Fire Brick laid in KROMEPATCH cement insures:—

Longer Furnace Life—Higher Combustion Efficiency
Fewer Boiler Shut-Downs—Lower Furnace Upkeep
Furnace Walls will not collapse.

Our Refractories Engineers present in Bulletin 10-3-A some of the Economical applications of KROMEPATCH in B. & W. Cross Drum Boilers.

Write us for your copy of this new Bulletin

DISTRIBUTORS:

Atlanta, Ga.
V. H. Kriegshaber & Son
Birmingham, Ala.
F. J. Evans Engrg. Co.
Boston, Mass.
G. P. Anderson
Buffalo, N. Y.
E. J. Eddy
Chicago, Ill.
E. J. Lavino & Co.
Thomas Moulding Brick Co.
Cincinnati, Ohio
Charles Taylor Sons Co.
Dallas, Texas
Moore & Company
Detroit, Mich.
R. D. Peebles
El Paso, Texas
Lee Fraser & Company
Hartford, Conn.
Windsor Cement Company
Milwaukee, Wis.
Witters Foundry Supply Co.
Mobile, Ala.
Turner Supply Company
Newark, N. J.
Dougherty-Walling Asbestos Co.
Pittsburgh, Pa.
E. J. Lavino and Company
Portland, Ore.
McCraken-Ripley Company
Reading, Pa.
Natural Products Co., Inc.
Rochester, N. Y.
E. J. Eddy
Seattle, Wash.
McCraken-Ripley Company
Syracuse, N. Y.
Roberts Tool and Supply Co., Inc.

Warehouse Stocks also carried at Baltimore and St. Louis

Manufactured by Refractories Division

E. J. LAVINO AND COMPANY

Bullitt Bld'g., PHILADELPHIA

PIONEERS IN CHROME REFRACTORIES

ALPHABETICAL INDEX TO ADVERTISEMENTS

This index is published as a convenience to the reader. Every care is taken to make it accurate, but POWER assumes no responsibility for errors or omissions.

Page

A

Abendroth & Root Mfg. Co.. 63
Advance Packing & Supply Co. 86
Air Preheater Corp. 50
Alberger Heater Co..... 50
Alfit Mfg. Co. 74
Allen-Sherman-Hoff Co..... 58
Allis-Chalmers Mfg. Co..... 89
American Engineering Co..30-31
American Hoist & Derrick Co. 58
American Mond Nickel Co... 81
American Pipe Bending Machine Co. 64
American Pulverizer Co..... 58
American Radiator Co..... 71
American Schaeffer & Budenberg Division, Consolidated Ashcroft Hancock Co..... 72
American Steel & Wire Co.. 81
Armstrong Machine Works. 21
Atlas Valve Co. 68
Auburn Stoker Corp..... 54

B

Babcock & Wilcox Co..... 42
Badger & Sons Co., E. B.... 61
Bailey Meter Co. 24
Baker Co., R. H..... 68
Banner Rock Products Co... 74
Bartley Crucible Co., Jonathan 95
Beaumont & Co., R. H..... 96
Bernitz Furnace Appliance Co. 55
Biddle, James G. 73
Bigelow-Liptak Corp. 96
Boiler Engineering Co..... 54
Boiler Tube Co. of America. 46
Bowser & Co., S. F..... 67
Bristol Co. 71
Buffalo Forge Co. 52
Buffalo Steam Pump Co.... 80
Burt Mfg. Co. 76

C

Celite Products Co.....65-66
Cement-Gun Co. 81
Chaplin-Fulton Mfg. Co. ... 62
Chesterton Co., A. W..... 86
Clarage Fan Co. 91
Coatesville Boiler Works... 42
Cochrane Corp. 37
Coen Company 54
CoKal Stoker Corp. 52
Combustion Engineering Corp. 14-15
Conneaut Packing Co..... 73
Connelly Boiler Co., D..... 44
Connery & Co. 3
Consolidated Ashcroft Hancock Co. 11
Coppus Engineering Corp.... 1
Crane Co. 69
Crane Packing Co. 76
Crosby Steam Gage & Valve Co. 72
Custodis Chimney Constr. Co., Alphons 56
Cyclone Grate Bar Co..... 51

D

Dampney Co. of America... 46
Dart Mfg. Co., E. M..... 64
Davis Regulator Co., G. M. Fourth Cover
Dearborn Chemical Company 50
DeLaval Separator Co..... 75
DeLaval Steam Turbine Co. 40

Page

Detrick Co., M. H..... 56
Detroit Stoker Co..... 52
Diamond Power Specialty Corp. 86
Directory of Engineering..82-83
Dodge Mfg. Corp. 76

F

Economy Pumping Machinery Co. 52
Edge Moor Iron Co..... 44
Elliott Co. .....3rd Cover, 6-7
Ellis Drier Co. 71
Evens & Howard Fire Brick Co. 56

F

Flexitallic Gasket Co. 74
Flynn & Emrich Co..... 56
Foster Wheeler Corp. 22-23
France Packing Co. 73
Frederick Iron & Steel Co... 62
Fuller Lehigh Co. 26
Fulton Iron Works Co..... 79

G

Gardner Denver Co. 86
Garlock Packing Co. 73
Garratt-Callahan Co. 46
Gas Combustion Co..... 40
General Electric Co. 20
General Insulating & Mfg. Co. 29
General Refractories Co. ... 86
General Specialty Co..... 44
Golden-Anderson Valve Specialty Co. 2
Green Fuel Economizer Co... 51
Greene, Tweed & Co., Fourth Cover
Grinnell Co. 64
Griscom-Russell Co. 33
Gruendler Patent Crusher & Pulverizer Co. 47-48

H

Hagan Corp. 17
Hammel Oil Burning Equipment Co. 54
Harbison-Walker Refractories Co. 56
Hedges-Walsh-Weidner Boiler Co. 42
Heinicke, H. R. 58
Hercules Float Works 96
Homestead Valve Mfg. Co... 10
Hoppes Mfg. Co. 50
Howard Iron Works..... 50
Hunt Co., C. W. 46

I

Illinois Stoker Co. 54
Industrial Brownhoist Corp. 58
Ingersoll-Rand Co..... 43
International Combustion Engineering Corp.....14-15
International Nickel Co..... 81
I-T-E. Circuit Breaker Co., Second Cover

J

Jefferson Union Co. 16
Jenkins Bros. 4

Page

K

Keasbey & Mattison Co..... 36
Kellogg Co., M. W..... 60
Kelly Foundry & Machine Co. 51
Kennedy Valve Mfg. Co..... 68
Keystone Refractories Co.... 56
King Refractories Co. 25
Kingsford Fdry. & Machine Works 44

L

Laclede-Christy 58
Laclede Stoker Co. 52
Lagonda Mfg. Co. 44
Lavino & Co., E. J..... 97
Leavitt Machine Co. 70
Lecourtenay Co. 60
Liberty Mfg. Co. 44
Link-Belt Co. 93
Lunkenheimer Co. 68

M

Magnolia Metal Co. 74
Manistee Iron Works Co. .. 62
Marion Mach. Fdry. & Supply Co. 51
Marley Company 60
Mason Regulator Co. 59
McClave-Brooks Co. 57
McGraw-Hill Book Co. ..43, 70
McLeod & Henry Co. 53
Metallo Gasket Co. 73
Midwest Piping & Supply Co. 63
Moore Steam Turbine Corp. 40
Morehead Mfg. Co. 70
Murray Iron Works Co. 40

N

Nash Engineering Co. 62
Nason Mfg. Co. 71
National Aluminate Corp. .. 41
National Valve & Mfg. Co. . 64
Neemes Foundry 52
Nicholson & Co., W. H. 70
Nordberg Mfg. Co. 87
Northern Equipment Co. ... 5
Nugent & Co., W. W. 76
Nuttall Co., R. D. 76
(Westinghouse Electric & Mfg. Co.)

O

Obermayer Co., S. 27
Otto Engine Works 77

P

Page Contracting Co., Frederick 54
Peabody Engineering Corp.. 52
Peale, Peacock & Kerr 60
Pennsylvania Pump & Compressor Co. 40
Permutit Co. 49
Philadelphia Gear Works... 76
Pittsburgh Coal Co. 60
Pittsburgh Piping & Equipment Co. 68
Pittsburgh Valve Fdry. & Construction Co. 68
Plibrico Jointless Firebrick Co. 39
Platt Iron Works 68
Power Piping Co. 64
Prat-Daniel Corp. 50

Page

Q

Quaker City Rubber Co. 74
Queens Run Refractories Co. 56

R

Republic Flow Meters Co. .12-13
Riley Stoker Corp. 28
Roto Company 46
Rust Engineering Co. 56

S

Sarco Company 70
Scherr Co., Geo. 72
Schuchardt & Schutte 72
Schutte & Koerting ..62, 72, 74
Searchlight Section 84-85
(See alphabetical index listed below)
Simplex Valve & Meter Co... 71
Smoot Engineering Corp. ... 52
Smooth-On Mfg. Co. 35
Spray Engineering Co. 60
Springfield Boiler Co. 42
Squires Co., C. E. 70
Standard Wire & Tube Co. .. 44
Sterling Engine Co. 40
Sterling Eng. & Mfg. Corp. . 71
Strong-Scott Mfg. Co. 54
Sturtevant Co., B. F. 32
Sullivan Machinery Co. 45
Swartwout Co. 9

T

Taylor Instrument Co.'s 72
Templeton Mfg. Co. 71
Templeton Steam Trap Co. .. 71
Terry Steam Turbine Co. ... 34
Toledo Pipe Threading Machine Co. 64
Trerice Co., H. O. 71
Tri-Lok Co. 96
Troy Engine & Mach. Co... 8
Tyler Tube & Pipe Co. 46

U

Union Iron Works 44
United States Graphite Co. 81

V

Vacuum Oil Co. ....Front Cover
Vogt Machine Co., Henry .. 40
Vulcan Soot Cleaner Co. ... 86

W

Westco-Chippewa Pump Co.. 60
Wheeler Mfg. Co., C. H. ... 62
Wickes Boiler Co. 42
Williams Valve Co., D. T. .. 70
Wing Mfg. Co., L. J. 51

Y

Yarnall-Waring Co. ...18-19, 60

Z

Zernickow Co., O. 72

INDEX TO SEARCHLIGHT SECTION

Bell & Zoller Coal & Min. Co. 84
Davis, J. F. 85
Fuerst Friedman Co. 85
Land, L. J. 85
O'Brien Machy. Co. 85
Positions Vacant and Wanted 84
Randle Machinery Co. 85
Sachsenmaier Co., George.. 85
Stewart & Co., Paul 84-85
Scioto Valley Rwy. & Pur. Co. 85
Zelnicker, W. A. 84